FAUNA

OF THE NATIONAL PARKS

OF THE

UNITED STATES

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FAUNA
OF THE NATIONAL PARKS
OF THE
UNITED STATES

A PRELIMINARY SURVEY
OF FAUNAL RELATIONS IN NATIONAL PARKS

By

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Photographs by Joseph S. Dixon except as otherwise indicated

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FOREWORD

This is the first of a series of reports dealing with the vertebrate fauna of the national parks to be prepared in the Branch of Education and Research of the National Park Service, Department of the Interior.

In addition to treating of the vertebrate natural history of the parks still requiring basic surveys, the reports will cover research in one branch of the science that is the very foundation upon which the National Park Service is built, namely, the preservation of the native values of wilderness life. For it is this ideal above all else which differentiates this service from its sister services in government.

The rescue of this prized heritage of the American people has created unique problems in road construction, landscape architecture, education, and administration, but in no field are the complications deeper and their solutions more obscure than in conservation of the wild-life resources. The parks' faunas have been extremely sensitive to the influences of civilization. The present paper details the conclusions of a general investigation of the vertebrate life of the national parks with emphasis on these human relationships.

Acknowledgement is made to those who have fostered the preliminary survey. From its initiation, the project has been under the personal guidance of Director Horace M. Albright, of the National Park Service. Without his constant support and the ready help of his assistants, a survey of such comprehensive character would have been impossible. Since Assistant Director Harold C. Bryant assumed his post in 1930, he has greatly assisted the progress of the work. Senior Park Naturalist Ansel F. Hall facilitated the office organization in many ways.

Dr. Carl P. Russell, field naturalist, was instrumental in the original conception of the idea and has both inspired and advised the survey all along the way. Dr. Joseph Grinnell and his coworkers in the Museum of Vertebrate Zoology, University of California, have graciously placed their facilities and advice at our disposal.

FAUNA OF THE NATIONAL PARKS OF THE UNITED STATES

APPROACH TO WILD-LIFE ADMINISTRATION

The national parks of the United States began by rescuing from the immediate dangers of private exploitation certain areas which were climax examples of Nature's scenic achievements.

With rapid expansion of frontiers to the end that European culture not only replaced that of the red man but actually altered the physical appearance of his environment, the national parks were quickly projected into a larger sphere of purpose. This involved a magnificent conception. The American people intrusted the National Park Service with the preservation of characteristic portions of our country as it was seen by Boone and La Salle, by Coronado, and by Lewis and Clark. This was primitive America, and it was to be kept for the observation of the recreation-seeking public and scientists of to-day, and their descendants in the generations of to-morrow.

PLACE OF WILD LIFE IN AMERICA'S CIVILIZATION

Throughout the new land, the wild-life resources were a vital necessity to the explorer. He penetrated the wilderness for fur. This was the first great crop to be harvested. Wherever he went, he depended upon the game for his very existence. So it was inevitable that the history and tradition of our national life should be replete with references to the animals that occurred so profusely. Emblematically, we live among these birds and animals to-day. Witness the eagle and the buffalo of our coins, the antlered emblems of fraternal orders, the wild creatures depicted on State flags and seals. Daily speech bristles with descriptive words based on concepts of these animals and their habits.

Yet many species continue to exist in the living state only as small remnants hidden away in the wildest corners of the country, remote from the perils of human contact. Others have persisted through their ability to escape greedy human eyes. With the alteration of their habits to meet the rigors of civilization, many of them are no longer to be observed in their primitive state.

To all of this the national parks present one of the outstanding exceptions. In them, the carnivores classed as predatory find their

only sure haven. Fur-bearers and game have benefit of partial protection elsewhere, but in the parks alone are they given opportunity to forget that man is the implacable enemy of their kind, so that they lose their fear and submit to close scrutiny.

The national parks owe much of their unique charm to the unusual opportunities they afford for observing animals amid the intimacies of wild settings in which even the observers feel themselves a part. It is one of the causes contributing to their constantly increasing popularity. The thrill of being in the same meadow with an elk, no fence or bar between, reaches everyone, young or old. Without the scurry and scratch of a chipmunk along the bark or the call of a jay and the flash of its blue, the high mountain and the deep gorge would be cold, dead indeed. The visitor would not linger long after his first comprehensive gaze at awesome scenery if the vista did not include the intimate details of those living things, the plants, the animals that live on them, and the animals that live on those animals.

Appreciation of the importance that the wild life commands among the resources of the national parks rests upon comprehension of the important points developed above.

In logical sequence, these points are:

1. That the wild life of America exists in the consciousness of the people as a vital part of their national heritage.
2. That in its appointed task of preserving characteristic examples of primitive America, the National Park Service faces an especially important responsibility for the conservation of wild life. This is emphasized by the wholesale destruction which has decimated the fauna in nearly every part of the land outside of the park areas.
3. That the observation of animals in the wild state contributes so much to the enjoyment derived by visitors that this is becoming a park attraction of steadily increasing rank.

CONSERVATION OF THE WILD-LIFE RESOURCES OF THE PARKS

Recognition of these factors by those entrusted with the care of the parks led to intensification of the protective function until vandalism was wiped out, while poaching has been reduced to a minimum in all but a few parks where it, too, will be eliminated as conditions grow more favorable. But this part of conservation has not been enough. The need to supplement protection with more constructive wild-life management has become manifest with a steady increase of problems both as to number and intensity.

An early example of classic note is the bison of Yellowstone. The necessity of saving the bison left no alternative to intensive management. No one questioned the sacrifice of policy involved in the maintenance of the herd in a state that was only semiwild. It

FIGURE 1.—American badger, one of the fur-bearers that is losing its fear of man in the national parks. Photograph taken June 25, 1930, near Lamar River, Yellowstone. Wild Life Survey No. 699

FIGURE 2.—Long-crested jay looks out over the Grand Canyon rim. "Without . . . the call of a jay and the flash of its blue, the high mountain and the deep gorge would be cold, dead indeed." Photograph taken October 30, 1930, at El Tovar, Grand Canyon. Wild Life Survey No. 1904

was either that or lose the great buffalo to this country except as Exhibit A in a zoological garden.¹ Still, this case was an exception, and no one even for a moment considered that it established a precedent for dealing with other species.

The policy of noninterference with wild life became more and more deeply entrenched. Protection would do the rest. Nevertheless, time proved that management of some sort would have to be invoked to save certain situations, especially as the parks were opened to thousands of visitors, causing a flood of fresh complications.

FIGURE 3.—American bison frequent a lake-bottom wallow. Management was necessary to preserve this member of the park fauna. Photograph taken September 17, 1929, Lamar Valley, Yellowstone. Wild Life Survey No. 415

The conclusion was unavoidable. Protection, far from being the magic touch which healed all wounds, was unconsciously just the first step on a long road winding through years of endeavor toward a goal too far to reach, yet always shining ahead as a magnificent ideal. This objective is to restore and perpetuate the fauna in its pristine state by combating the harmful effects of human influence.

The park faunas face immediate danger of losing their original character and composition unless the tide can be turned. The vital significance of wild life to the whole national-park idea emphasizes the necessity for prompt action. The logical course is a program of

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¹ The Extirpation of the American Bison, with a Sketch of its Discovery and Life History, by Hornaday, William T. Report of United States National Museum, 1887, pp. 369-548.

complete investigation, to be followed by appropriate administrative action.

The unique feature of the case is that perpetuation of natural conditions will have to be forever reconciled with the presence of large numbers of people on the scene, a seeming anomaly. A situation of parallel circumstance has never existed before. Therefore, the solution can not be sought in precedent. It will challenge the conscientious and patient determination of biological engineers.² And because of the nature of the task, it is inherently an inside job. Constancy to the objective can be made a certainty only by employment of a staff whose members are of the Service, conversant with its policies, and imbued with a devotion to its ideals.

HISTORY AND PROGRAM OF THE SURVEY

During service with the educational department in Yosemite National Park in 1928 and 1929, thoughts of this trend led one of the writers to the hope that something might be done towards concentrating greater interest on the fundamental aspects of wild-life administration throughout the national-park system. In collaboration with another of the co-authors, the general outline for a preliminary investigation was developed. Having received the sanction of the director, the idea then assumed concrete form under his guidance, becoming at once the Preliminary Wild Life Survey, with headquarters at Berkeley, California.

Personnel included Joseph S. Dixon, economic mammalogist; George M. Wright, scientific aide in the National Park Service; Ben H. Thompson, research associate; and Mrs. George Pease, secretary. All expense of the survey, inclusive of office, field, and salaries, was met with private funds until July 1, 1931. Since then it has been supported about equally from public appropriation and private contribution.

Stated objectives were:

1. To focus attention upon the need for a well-defined wild-life policy of the National Park Service, including the extension of the protective function to embody a definitely constructive program.
2. To assist park superintendents in dealing with the urgent animal problems immediately confronting them.
3. To present a report which would delineate the existing status of wild life in the parks, analyze unsatisfactory conditions, and outline a proposed plan for the orderly development of wild-life management.

The present paper is intended to fulfill the third objective. In the meantime certain results have been attained toward the accomplishment of the first and second purposes and may be mentioned briefly here.

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² A designation applied by Dr. Alexander Ruthven and others to workers in this field.

Through the existence of a group actively functioning in the field, the director was provided with arguments and data and with a living organization for which he could solicit support to assure perpetuation. This has facilitated the securing of one permanent position of field naturalist and appropriations to cover the field expenses of the staff. Office quarters were provided in conjunction with field offices of the Branch of Research and Education of the National Park Service in Hilgard Hall, University of California, Berkeley, Calif. Thus the foundations of a wild-life organization as a continuing function of the Service have already been laid.

The photographic collection, numbering 2,523 negatives and accompanied by prints all filed and indexed in readily available form, is proving useful to the educational program. Though its prime purpose is for scientific record, the service rendered in this other field increases its value measurably.

Field notes on 279 species of birds and mammals have been systematically recorded. In part they have provided data for the report, but the whole of them remains an important reservoir of classified information for the intensive biological studies which should follow the first general investigation.

Nevertheless, throughout the preliminary survey, fixity to the main purpose of obtaining a perspective of the problem in its entirety has been the paramount consideration. Consequently, the search focused on the general trends in the status of animal life, with particular regard to the motivating factors. If a finger can be placed on the mainsprings of disorder, there is hope of discovering solutions that will be adequate in result. Meeting existing difficulties with superficial cures might be temporarily expedient and, in cases of emergency, necessary, but if continued would build up a costly patchwork that must eventually give out. It would be analogous to placing a catch-basin under a gradually growing leak in a trough and then trying to keep the trough replenished by pouring the water back in. The task mounts constantly and failure is the inevitable outcome. The only hope rests in restoration of the original vessel to wholeness. And so it is with the wild life of the parks. Unless the sources of disruption can be traced and eradicated, the wild life will ebb away to the level occupied by the fauna of the country at large. Admitting the magnitude of the task, it still seems worth the undertaking, for failure here means failure to maintain a characteristic of the national parks that must continue to exist if they are to preserve their distinguishing attribute. Such failure would be a blow injuring the very heart of the national-park system.

The field studies were conducted in accordance with this point of view. Findings as presented in this report are calculated to lay a

foundation of approach and practice useful in dealing with wild-life problems of all categories wherever or whenever they may occur, rather than to stand as an enumeration of a lengthy list of individual problems without correlation. However, numerous examples have been given detailed treatment in the development of the arguments, and in a separate section all problems met with in each area have been enumerated in order to record for future reference the situations obtaining in the parks at the time of the investigation, as seen by the field party.

In the following pages the technique developed for the preliminary survey is detailed for the benefit of others who may undertake similar projects and for the usefulness it will have as a skeletal outline for the intensive studies in each park later on. Further, this account of the methods employed will facilitate a critical evaluation of the results.

METHODS ADAPTED TO FAUNAL INVESTIGATIONS IN NATIONAL PARKS

When the survey party went into the field in May, 1930, its members purposely had not formulated an outline of procedure in advance. Preparations were confined to assembling the necessities for living in the open under a variety of conditions and the paraphernalia for making observations and recording data. The essen-

FIGURE 4.—A high-mountain glade, soon to be converted into a camp ground. "How could the animal life be conserved under natural conditions and still contribute fully to the enjoyment of the people?" Photograph taken October 4, 1930, near Shadow Lake, Mount Rainier. Wild Life Survey No. 1327

tials consisted of a sturdy field car, camp goods, photographic supplies, collecting kit, and a few standard reference books.

It had been previously agreed that an independent procedure, that is, one guided by no former experience or prejudice, should be developed from knowledge gained on the ground. If the findings were to have even a fair chance of being unbiased, there must be freedom from any preconceived method of survey. It was believed that this approach would favor the development of the technique best suited to the problem.

The importance of starting in this manner is best explained in the object of the survey. The only reason for attempting this practical type of investigation was to provide park administrators with data which would help them to meet a new and difficult situation. How could the animal life be conserved under natural conditions and still contribute fully to the benefit and enjoyment of the people?

As for individual biases, there were already too many. The park superintendent stood at the crossroads between the wild life and various groups of interested persons with their conflicting biases. Among them were those of the man who judged the park in terms of fish in its streams, the hunter who wanted the maximum production of game though he could not shoot it, the scientist who would exclude people from large areas in order that their potentialities as pure cultures for zoological research might not be destroyed, the visitor who would prefer to have the animals fenced by the roadside for easy inspection from his car, and the person who eschewed the intrusion of any artificiality, even a road, in the native haunts of the wild creatures. Nor can one forget such well-meant suggestions as that of the cattleman who wanted to place a herd of purebreds along the entrance road inside a park in order to add to the interest—and so it would, for him and many other stockmen.

It was believed that the type of investigation which would come nearest to satisfying the needs of the Service was one that would furnish accurate data on the status of parks' fauna, with due emphasis on the economy or human relationships of each species. For this reason, the first weeks were devoted to the study of each park visited in its entirety, trying to analyze all factors which either affected the animal life or, conversely, were themselves influenced by the animal life. The administration, the visitors, structures erected by man, and the territory outside the park were scrutinized just as much as the animal populations. The vertebrates themselves received much the larger share of attention later on, but these other factors continued to figure prominently throughout.

The plan of procedure and the methods evolved in these first weeks were practiced and further developed throughout the period. This plan is discussed here and then presented in outline form for reference in subsequent studies. Four distinct steps or divisions were recognized as necessary to the completion of a survey, though at least three of them might be undertaken simultaneously.

FOUR STEPS IN SURVEY'S PROCEDURE

The first step is to reconstruct the picture of the fauna of the area as it existed in its undisturbed environment before white men came. This logically is the first thing that must be known, because

the object of all subsequent work will be to study the changes which have occurred in the meantime and to restore or maintain, as the case may be, the faunal part of this early picture.

The second step is to study the history of the area under man's dominance. This serves to reveal the causes for the present maladjustment of many species. Roots of existing conditions are often buried deep in the past, and before they can be understood and corrected these roots must be dug out.

The third step is so obvious that it requires little comment. It involves a complete survey of the vertebrate life as it exists in the park at present, inclusive of systematics, life history, and ecology, with a complete treatment of man as one of the environmental factors.

The fourth step is to draw up an initial broad management plan that will guide wild-life administration towards the general objective, which is to approach as nearly as possible the picture set up in the first step. This plan should be elastic and must be subjected to constant revision on the basis of future studies or it will soon become obsolete.

Thus, in any park, the determination of original conditions will provide the goal of management. Study of the historical past and of present circumstances will provide the working data upon which the management plan of the future can be built.

THE PRIMITIVE WILD-LIFE PICTURE

It is true that flora and fauna and even geography itself have been in a state of flux since the continents first rose from the sea, and in this sense there is no one wild-life picture which can be called the original one. Nevertheless, practical considerations determine one point in time which satisfies wild-life-survey requirements as regards a particular area. This is the period between the arrival of the first whites and the entrenchment of civilization in that vicinity. We can know little of the other pictures that preceded this period and violent changes occurred immediately afterward. Consider this from another viewpoint. The rate of alteration in the faunal structure has been so rapid since, and relatively so slow before, the introduction of European culture that the situation which obtained on the arrival of the settlers may well be considered as representing the original or primitive condition that it is desired to maintain.

When it comes to defining the original status of each animal in a region, allowance must be made for cyclical fluctuations in animal populations. In some species the high and low ebbs in density per unit area may be extreme even under normal conditions. However, this occurs more noticeably in the smaller forms with a high birth rate.

Along with learning what species comprised the fauna of the area, what the abundance of each was, and what range was occupied at each season, as much information as possible should be assembled on the vegetative cover. Where the plant life has changed as to com-

FIGURE 5.—Maria, last of the Yosemitees, told the party about early wild-life conditions in the valley. The records of first-hand observations are important and should be sought before it is too late. Photograph taken July 7, 1929, Yosemite. Wild Life Survey No. 324

position and distribution, it would be fruitless to hope that the animal life could remain the same.

Obstacles to reconstructing the primitive picture are great in any instance, but they increase in places where the pioneer period dates

very far back. The material evidence was largely perishable and may have been completely destroyed. Accounts that have passed from mouth to mouth are likely to be worse than useless. People who left any written record were few, and of these still fewer could be counted reliable observers.

Yet every small fragment of fact that can be sifted out and added to the mosaic is of value and will become much more so all the time. Because the chance of completing these early pictures grows less each year, this part of the survey should be undertaken immediately and pushed as rapidly as possible. In the West some of the pioneers who first saw the regions that are now national parks are living, so that first-hand statements can still be secured. The record of primitive conditions should be carefully substantiated as it is drawn up. The park museums are the proper repositories for accumulated evidence.

Old game trails, salt licks, and wallows tell a story that can be recorded photographically. Shed antlers and old horns, as well as other skeletal remains, give clues to the type of habitat occupied under natural conditions and to the original range of species which may have been extirpated since or forced to change their haunts.³ Evidence of this sort should be photographed in place, and both specimens and pictures placed in the local museum.

References to animal life in early writings should be treated in the same way.⁴ Where the original letter or document can not be secured, photostatic copies, accompanied by full data on the source, will serve very well. Pertinent material may be gleaned from newspapers, periodicals, scientific reports, travel accounts, and even from historical fiction built around frontier life. In this connection, maps, paintings and drawings by both white men and Indians should not be overlooked. Just as with the restoration of Williamsburg, the search for clues to the restoration of the early picture may lead almost anywhere, not excepting the Old World.

HISTORY OF FAUNA UNDER MAN'S INFLUENCE

This second step of a wild-life survey might be likened to making a moving picture as compared to the first step just discussed, which is more like assembling the elements of a still picture. The primitive picture melted into a rapidly changing scene when people came in numbers. The historical study will discover the new influences at work on the fauna and some of the results.

³ Mammal Remains from Two Prehistoric Village Sites in New Mexico and Arizona, by Lyon, Marcus Ward, Jr., *Proc. U. S. Nat. Mus.*, vol. 31, 1907, pp. 647-649.

⁴ U. S. Geological Survey of Montana, Idaho, Wyoming, and Utah, 1872, by Hayden, F. V., 1873.

FIGURE 6.—Claw marks on trees may tell the story of bears that have since disappeared. Photograph taken at Tower Falls Ranger Station, Yellowstone, July 14, 1931. Wild Life Survey No. 1929

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This study has two parts. Tracing the story since the date of the creation of the park is relatively much the easier part. Superintendents' reports provide a continuous record. Animals and birds of a park are under constant observation by members of the administrative staff. Scientists have used parks for research laboratories and published their findings. Such complete studies as *Animal Life in the Yosemite*⁵ and *Vertebrate Natural History of the Lassen Peak Region*⁶ are of invaluable assistance here.

The more difficult part of the historical study is to trace the factors affecting the fauna of the area backwards from the time it was made a park to the days of its discovery and exploration. Yet this is

FIGURE 7.—Ranches preempted valley bottoms which were critical areas for game in winter. Photograph taken June 26, 1931, in Beaver Park, Rocky Mountain. Wild Life Survey No. 1845

likely to be the most important period, for the influences most inimical to wild life held their greatest sway then. The history and effects of these early influences must be sought out if the present status of the vertebrates is to be really understood.

The several major occupations of man in wresting a living from the new land have each left an imprint on the fauna. Where the activity was trapping and hunting, especially market hunting, the effect was soon apparent. Other pursuits, such as cattle raising and

⁵ *Animal Life in the Yosemite*, by Grinnell, Joseph, and Storer, Tracy I. University of California Press, Berkeley, Calif., 1924.

⁶ *Vertebrate Natural History of a Section of Northern California Through the Lassen Peak Region*, by Grinnell, Joseph, Dixon, Joseph, and Linsdale, Jean M. University of California Press, Berkeley, Calif., 1930, pp. 85-86.

FIGURE 8.—Near many parks, forest cover is being removed bodily and the fauna must change in consequence. Photograph taken September 17, 1931, at White River entrance of Mount Rainier. Wild Life Survey No. 1847

farming, had influences which were not always so conspicuous, but the ultimate harm done may have been even greater. The impoverishment of the range by domestic stock has had an almost incalculable effect upon the native life. It was most obvious on the game, but, of course, the predators were involved in turn, and so on. As is always the case with Nature's ecologic structure, the disturbance of one species has repercussions the end of which we are as yet unable to see or predict. It would be hard to find any form of wild life that was not in some way affected by stock on the range. Agriculture caused many changes. Irrigation destroyed certain animal-plant communities, replacing them with others. Ranches preempted valley bottoms which were critical areas for the game populations of entire mountain areas in severe winters, thus threatening their complete annihilation. Cultivated crops favored the enormous increase of certain rodents over the normal numbers for wild land. Accidentally and intentionally, the farmers introduced exotics. Railroads and logging operations likewise had their share in the changes that took place. Game ranges were divided. The fire element was magnified. Forest cover was removed bodily.

In studying the history of the areas in relation to the effect upon wild life, it is helpful to group the influences by the different phases of human activity which caused them. In doing this, faunal fluctuations not traceable to civilization must not be overlooked.

Methods for this second step of the survey are much the same as would be invoked for the first step, and so do not need to be discussed separately here. But the difficulties are less in proportion that there is much more material to draw upon.

SURVEY OF PRESENT STATUS OF VERTEBRATE LIFE

Though this step is a more satisfactory one to undertake than the first two in that it is clean-cut with all materials at hand, it is also the most exacting as to thoroughness of the results required.

First a complete study skin collection for the area should be made and housed in the park museum. Large series of skins are not necessary, but each species should be represented in all seasonal and developmental phases.

The life history of each species should be worked out for that area. It is not sufficient to have reference to the behavior of a closely related form or even the same form in another distant locality. Needless to say, the life-history studies would not approach completion for many years, even though systematic studies were instituted immediately.

In this basic vertebrate survey a highly important phase is the study of the park animals in a new environment with man as a potent ecological factor. Man in the park must be considered as part of the whole that is the park. Thus, the effects of his presence on the wild life must be carefully analyzed and dealt with as continuing problems in whatever administrative plan is finally adopted.

DEVELOPMENT OF A MANAGEMENT PLAN

Not until the three foregoing steps have been substantially worked out for a given area will it be possible to set up a management plan that can be characterized by any other name than make-shift. The task may be considered burdensome, yet without a program of wild-life administration based on a painstaking survey containing all these elements the wild life will deteriorate further and further.

RECAPITULATION

The foregoing discussion explains the wherefore of the several steps in procedure developed in the course of the preliminary wild-life survey and which were followed out as far as possible considering the broad field and the time allowed. This plan is here presented in outline form, indicating the methods for securing the data required in the first steps and suggesting how the last step, the administrative plan, can be predicated on this data.

OUTLINE OF FAUNAL-SURVEY'S PROCEDURE

I. Determine original status of fauna in the park region.

Object—

- A. To define the goal of wild-life management.
- B. To establish definitely the comparative basis for analyzing subsequent faunal changes.

Method—

- A. Study the evidence on the ground.
  - 1. Old game trails, salt licks, wallows, etc.
  - 2. Skeletal remains, horns, antlers, etc.
- B. Interview pioneers, early residents, etc.
- C. Search written records.
  - 1. Letters and diaries.
  - 2. Printed sources, inclusive of periodicals, books, scientific reports, etc.
  - 3. Paintings and drawings by Indians and white men.

II. Determine the history of the fauna of the region under white man's influence.

Object—

- A. To trace causes of present conditions.
- B. To learn what unfavorable influences may be averted in history yet to be made in newer projects.

II. Determine the history of the fauna of the region under white man's influence—Continued.

Method (in general, the same methods as outlined under I, above, are applicable)—

A. Study the era prior to creation of park by the several steps of economic development in that region.

1. Direct influences.
  - a. Trapping.
  - b. Hunting for sport.
  - c. Market hunting.
2. Indirect influences.
  - a. Grazing.
  - b. Agriculture.
  - c. Lumbering.
  - d. Railroad development.

B. Study history of the fauna under park administration.

1. Investigate history of wild-life administration.
  - a. Poaching and patrol.
  - b. Predatory-animal control.
  - c. Other protection and management measures.
2. Determine effects of development as a national park.
  - a. Increase of visitors.
  - b. Road and structures developments.
  - c. Developments adjacent to park boundaries.

III. Intensive survey of present vertebrate life of the park.

Object—To learn as much as possible about all forms and their economy.

Method—

A. Make a complete study skin collection for the park museum.

B. Work out life histories of all species.

1. Concentrate first on species facing greatest danger and carry on to eventually include all.
2. Study the park animal in relation to the status of that species throughout its range.
3. Study other attempts to conserve certain species for hints in park work.

C. Study the human factor as a permanent factor in the ecology of the area.

IV. Develop a management plan.

Object—

- A. To maintain elements in present picture that still approximate the primitive state.
- B. To devise ways of restoring species which have departed from their original status.
- C. To make adjustments for species which can only be saved under semiartificial conditions.

Method—The management plan will be based on the data secured in the first three steps of the survey and will be developed as the result of experience in applying the knowledge so gained.

ANALYSIS OF THE MAJOR TYPES OF WILD-LIFE PROBLEMS THEIR CAUSES AND TREATMENT

THE BASIC CAUSES OF PRESENT FAUNAL MALADJUSTMENTS

When a roster of typical wild-life problems from the whole national park system was assembled, a very wide range of maladjustments was revealed. A systematic analysis was made to trace each problem back to the basic disturbance which brought it about. For if any common denominators could be found, that knowledge would be a key to devising a betterment plan. Early in the work it became apparent that the fundamental causes were relatively few. If a number of problems could be traced to a common origin, more rapid and orderly progress in wild-life administration would be possible than if each problem were dealt with as an isolated instance.

From this analytical study the conclusion was reached that present complications in the status and environmental relations of park animals have come from these three general sources:

1. **Adverse early influences.**—The present unsatisfactory status of an animal may be the result of a destructive force which itself is no longer active. These are problems caused by early influences. It is convenient to think of them as the problems of historical origin. Problems of this class fall into two groups, according to whether the influence was one which destroyed the fauna directly or one which operated indirectly by altering some part of the environment upon which the fauna depends.

2. **Failure of parks as independent biological units.**—A park is an artificial unit, not an independent biological unit with natural boundaries (unless it happens to be an island). The boundaries, as drawn, frequently fail to include terrain which is vital to the park animals during some part of their annual cycles. The smaller the total area of a park the more its animal life may be endangered by external influences. Problems caused by the failure of parks as biological entities have to do with their geographical aspects, such as size and boundary location. It is easy to think of them as problems of geographical origin. They logically fall into two groups, according to whether they have come from failure to include all habitats required by park animals or from external influences which do not find the boundaries a natural barrier.

3. **Conflict between man and animal in the park.**—Troublesome situations inevitably arise when men and certain animals with conflicting

interests try to occupy the same places at the same time. These complications come in spite of the human ideal that the wild life of the parks shall remain in a primitive state unmodified by civilization. Disturbances of this origin constitute the third class, the problems caused by conflict between man and animal through joint occupancy of the park areas. For brevity's sake they may be designated as problems of competitive origin. And once more it is profitable to make two divisions, this time according to whether problems are due to injury of man by the animals or due to man's occupation of the area affecting the fauna adversely.

FIGURE 9.—Occasionally the interests of men and animals conflict. A bear profited in this foray to the extent of one roast of lamb. Photograph taken September 11, 1929, at Canyon Lodge, Yellowstone. Wild Life Survey No. 452

These three basic causes are responsible for the multitude of problems which must be solved with at least fair success if the faunal resource of the national parks is to be conserved.

The administrative measures invoked in every instance must be gaged by accurate analysis of the causative factors which bred the problem. This is important. It is the key to proper practice in the program of wild-life administration upon which the parks have unavoidably embarked. In the end the Service either will be praised for intelligently conserving the last fragments of primitive America or condemned for failure to hold to the real purpose by shooting clear over the mark and practicing game farming instead.

The rigors of civilization have injured the fauna of the country as a whole. In a national park the damage can not be undone by policing a boundary line. This is protection and it is necessary, but it does not correct conditions already operative within the park. These must be sought out where they are doing damage and dealt with there. This is management, and the danger that it may be overdone is not sufficient reason for doing nothing.

Recognition that there are wild-life problems is admission that unnatural, man-made conditions exist. Therefore, there can be no logical objection to further interference by man to correct those conditions and restore the natural state. But due care must be taken that management does not create an even more artificial condition in place of the one it would correct.

If each problem is carefully analyzed as to its cause, and the type of management appropriate to problems caused in that way is then applied, management will not destroy its own purpose. Admittedly, the tool is a dangerously sharp one to use in a national park. That is why it must be handled with skill in biological engineering, a science which itself is in its infancy.

It is important in every case that the hand of interference should not be exercised beyond the point that is necessary to do the work. In some instances if the situation responsible for the maladjustment of a species can be corrected, that bird or mammal will come back to its former status. Failing this, additional measures may be temporarily necessary to help it recuperate its strength. But where the basic disturbance can not be eliminated, management to counteract the evil effects may have to be instituted to continue so long as the harmful influence continues.

All of the problems which the survey has encountered to date are believed to be of historical, geographical, or competitive origin. The following outline lists major types of problems in each of these causative groups.

TYPE PROBLEMS LISTED BY CAUSE

CAUSE	PROBLEM
I. Earlier influences (historical)	
a. Operating directly-----	1. To re-establish an extirpated species.
	2. Treatment of a species reduced to danger point.
	3. To restore a depleted habitat.
b. Operating indirectly-----	4. Treatment of a species become unnaturally abundant.

CAUSE

PROBLEM

II. Failure of parks as independent biotic units (geographical)

a. Lack of complete animal habitat in park-----

b. Encroachment of external influences -----

5. Lack of winter range

6. Reduction of park animals black-listed outside.

7. Invasion of exotics into the park.

8. Dilution of native stocks by hybridization.

9. Exposure of native animals to diseases and influences of alien faunas.

III. Conflict between man and animal within the parks (competitive)

a. Animals interfering with man -----

10. Unusual damage to landscaping.

11. Conflicts with fish culture.

12. Animal injury to life or property.

b. Human developments harmful to wild life-----

13. Disturbances in development centers.

14. Effects of pasturing saddle horses.

15. Disturbances on breeding grounds.

16. Altered status because of manner of presentation.

The scope of this report prevents discussing at length every problem encountered. Consequently the plan has been adopted of discussing the essential elements of each type of problem listed above and illustrating each with one or more examples treated in detail. These examples will serve as type problems to which others resulting from similar causes can be referred for comparison and study. Then in later sections dealing with the vertebrate life of each park as a unit, only those problems on which the survey has accumulated special data have been accorded more than outline treatment.

Where it seemed that more than one of the major causes entered into a certain problem, close inspection revealed that one of them was dominant in producing the present situation. These have been handled by allocation under their dominant cause.

The type problems given in the next three sections are arranged in accordance with the foregoing outline. They have been numbered to conform with the Arabic numerals in the outline merely to facilitate reference and to further emphasize the relation of problem to cause.

PROBLEMS OF HISTORICAL ORIGIN

THE RESULTS OF EARLIER INFLUENCES

All depending upon the history of development of the region, the fauna of a park at the time of establishment was either much the same as it had been originally or it was greatly altered. The scheme of wild-life administration should meet the latter condition by corrective measures. Maladjustments caused by factors which have been eliminated from the park area will not necessarily correct themselves because these original causes are no longer operative. Where the status of species which have been adversely affected continues without showing improvement for a number of years after full protection has been established, management should be applied.

CONDITIONS CAUSED BY DIRECT EFFECT OF EARLY INFLUENCES

The status of wild life was impaired directly and immediately where animal populations were decimated by trapping, shooting, or poisoning. Some species were actually exterminated from the areas before they became parks. Others had been reduced to small numbers and recuperation has not resulted from park protection. Drains on a species from natural causes which are not ordinarily fatal because of an ample breeding stock may be overwhelming when it has been reduced to a few mated pairs per unit area.

TO REESTABLISH AN EXTIRPATED SPECIES (1)

Restoration of an animal which has been exterminated is desirable not only because it will bring back that species itself, but because it will fill once more the niche that was deserted, and so help to restore the life of the park to its primitive dynamic balance. If the extirpated species is still present in the region, reoccupation of the park by natural spread should be encouraged. This is the best answer from the standpoint of expense and likelihood of lasting success. If on the other hand, there are natural or artificial barriers in between the park and the present occupied area, restocking must be the answer. If the animal is decreasing everywhere, this step must be taken promptly.

Thus the procedure adopted for meeting the individual problem will be largely determined by the status of the animal outside the park, as is illustrated in the following examples:

Grizzly bears in Sequoia.—The grizzlies of California are extinct. The suggestion has been made a number of times that replacement be made with a Rocky Mountain grizzly. This would be such an obvious mistake that it has never been seriously considered, yet in other instances of this same kind the incongruity might be just as great though not so immediately apparent. If an animal is extinct, the situation is beyond remedy. Attempt to replace the original with a related form would merely serve to create a new problem, the introduction of an exotic with different characteristics and, more especially, different ecological requirements than its extinct relative.

Mountain sheep in Yosemite.—The Sierra Nevada mountain sheep (*Ovis canadensis sierrae*) disappeared from Yosemite before the close of last century. Old horns and skulls are still found about high cliffs. There is a living remnant of this bighorn in the southern Sierra near Mount Whitney, where it is reported to be slowly increasing under protection. Two other related subspecies are the Lava Beds bighorn to the north, which is probably extinct, and the Nelson bighorn, which is still extant on some nearby desert mountains to the south.

Many have already expressed a wish to see Yosemite National Park restocked with mountain sheep, there being even some indication that private support might be forthcoming for such a project. The waiting policy adopted by the Service is the only justifiable course for the present. So long as the Sierra Nevada form still exists, it is the only source which can even be considered for reintroduction purposes. A gradual return of the southern remnant is the ideal solution, and there is a fighting chance that this will take place if it continues to increase and reoccupies its range northward along the crest of the mountains. Continued heavy grazing by domestic sheep between Yosemite and Mount Whitney will be a serious obstacle here.

Even though natural reestablishment should be considered too remote a possibility, waiting would still be a necessity for practical reasons. The southern band is still small and the sheep are rarely seen. They should not be disturbed; but if they were, success in capturing the necessary number and transporting them to Yosemite would be very unlikely. It would not pay to release such costly animals as these would be near the crest of the mountains. The park unfortunately does not include the east slope, which is the habitat preferred by the sheep. They are particularly dependent on this side during the period of heavy snow, and would be without the benefit of park protection at such times.

To sum up, the conclusions in this problem are: Return of the mountain sheep to Yosemite should be planned for, because the

FIGURE 10.—Mount Dana. The eastern slope of the range, now outside Yosemite boundaries, would be needed by mountain sheep in winter. Photograph taken July 30, 1929, at Tioga Pass, California. Wild Life Survey No. 296

native form is still in existence; the procedure indicated by the elements of the case is to do nothing now except to watch the Mount Whitney sheep until either they work back naturally, or, failing that, become sufficiently abundant for a restocking experiment to have a chance of success.

Wild turkey in Mesa Verde.—In the foregoing example the return of the mountain sheep to Yosemite is shown to be desirable, providing it can be accomplished under the proper conditions. Let us examine a second case—one in which the basic action itself is in question.

The problem is: Should the Merriam Turkey (*Meleagris gallopavo merriami*) of the Southwest be placed in Mesa Verde National Park?

The Cliff Dwellers kept turkeys confined in the caves behind their dwellings. Turkey-bone implements and pieces of turkey-feather robes have been recovered, as well as many other evidences that the wild turkey was present and was an essential part of the Cliff Dwellers' economic, and possibly religious, life. There are no definite records or indications of the presence of turkeys on the mesa to-day. It would be of unusual interest and of educational value if these wonderful birds were occasionally seen, or, at least were known to be present, hidden in the forest and canyons of the mesa. In the thoughts of the visitor, these birds would be as a far cry back to that earlier life and culture, a symbol to link him more closely to that civilization as a reality. Their presence would lend a further charm and color to the wild life of the mesa to-day. But there are other considerations.

Is this the native habitat of the wild turkey? "It is significant that by choice we find them in or near the yellow-pine type and always where living water—springs or streams—is available. Nowhere, in the memory of the oldest citizens of the State, have turkeys been resident where pine was not in evidence. If for no other reason, the adult birds seem to insistently choose pine trees in which to roost."⁷ There is almost no yellow pine on the mesa, and water is very scarce.

Did turkeys ever exist here naturally, or were they brought here in a semidomesticated state by the Cliff Dwellers? If they were brought here, from where did they come? Probably the nearest representatives of the Merriam turkey are those found in the Chusca Mountains between Arizona and New Mexico, north of Gallup. However, they are in an extensive yellow-pine country, which is their native habitat. Since they are found so close to Mesa Verde, it would not be surprising to find that they were at one time native to the mesa, except for the scarcity of yellow pine and water.

The following note on the wild life of the Chusca Mountains region is given by Vernon Bailey: "The Navajo Indians in their religious

⁷ Wild Life of New Mexico, by Ligon, J. Stokley. State Game Commission, Department of Game and Fish, Santa Fe, N. Mex., 1927, p. 113.

reverence for feathered spirits have made their great reservation to some extent a bird preserve. Ducks are unmolested in the lakes and doubtless breed there in considerable numbers. Wild turkeys have held their own unusually well, but have suffered somewhat from hunting by outsiders and Christianized Indians.”⁸

Were turkeys left here after the Cliff Dwellers departed? If so, what has become of them?

If turkeys were not native to the mesa, would it not be confusing the whole significance of their part in Mesa Verde culture to place them there, and give the impression that they were native to the mesa? The significance of a visit to Mesa Verde is that it acquaints one with an earlier civilization through the actual remnants of that civilization, and it shows how that civilization was modified by, and adapted to, its particular environment. If we introduce an alien factor into the immediate setting, we are destroying the significance of the whole complex relationship between culture and environment.

These thoughts are not given to oppose the reintroduction of wild turkeys into this park. They are given simply as a preliminary analysis of the complexity of such a problem, and as an indication of some of the interactive factors which have to be considered before there can be a proper decision.

Once the desirability of reintroducing an exterminated species has been demonstrated, there are the practical problems to be worked out in the field, such as:

- (a) Where the nearest representative of the species may be found.
- (b) Practical means of securing pairs for reintroduction.
- (c) The matter of cost.
- (d) Practical measures, if necessary, for temporarily protecting the new stock until it establishes itself.

TREATMENT OF A SPECIES REDUCED TO DANGER POINT (2)

In discussing the problem of a species whose numbers have been reduced to the danger line by the pioneer depredations of man, it is admitted that possibly nothing can be done to bring that animal back to its former status. Yet even this knowledge can not be had without first making a thorough investigation of the question, including, perhaps, experiment with some betterment measures. On the other hand, many species might be brought back if their plights and all the governing factors were sufficiently understood. A temporary program of special protection to bring about recuperation might include securing greater immunity for the young against enemies on the breeding grounds, or augmenting the food supply at a critical

⁸ Life Zones and Crop Zones of New Mexico, by Bailey, Vernon. North American Fauna, No. 35, 1913, p. 61.

period, or some other measure, depending entirely, of course, on the individual circumstances of the case. In any event, every precaution should be taken against endangering the status of any other species while trying to help one; and, always, the special protection must be discontinued just as soon as the species is out of danger.

Trumpeter swan in Yellowstone.—This is perhaps the best example for this type of problem, not only because the number of trumpeter swans in the Yellowstone region was reduced to a few birds but because these represent the entire known breeding stock in the United States.

Though the trumpeter swan (*Cygnus buccinator*) and the whistling swan (*Cygnus columbianus*) are so much alike in appearance as to be almost indistinguishable in the field, the first has all but succumbed, while the latter continues to flourish. Comparison of the two forms is valuable in analyzing the present problem.

The whistling swan bred mainly north of the Arctic Circle, its nesting grounds unaffected by civilization. The trumpeter swan bred in Canada and the great interior valley of the United States, where it was subject to every adverse influence, even to the draining of many of the small breeding lakes.

As winter visitants in the south the whistlers were very shy, so that few were taken by gunners. They came down along the coasts and kept to open waters. The trumpeters, on the other hand, were much less wary, frequenting smaller bodies of water and coming in close to the hunters' blinds.

A whistler might weigh 18 pounds; a large trumpeter, 33. Consequently, the trumpeters made more desirable skins and must have been at a premium in the great swan trade of the Hudson Bay Fur Co., which destroyed the bulk of these birds, even to the northern part of their range, long before permanent settlement came along to do the rest.

As a result of all these influences the trumpeter swan nearly passed from the picture. Its present status is as follows:

In Canada: For conservation reasons, the Canadian Government keeps its data on this species a secret. It is known that a few winter in southern British Columbia, but their breeding grounds have not been discovered. They are believed to be in the northern part of the Province, where, if any colony is found out by Indian or prospector, it is sure to be destroyed.

In the United States: Though the trumpeter may possibly occur south of the international boundary in migration, it is gone as a breeding bird except in the immediate Yellowstone region. All recent nesting records are within the park except for two stations—Jackson Lake, Wyo., and Red Rock Lake, Mont.

The latest breeding census made by the survey party in 1931 showed 5 breeding pairs and 10 birds not breeding. The 5 nests are known to have hatched 18 cygnets, of which 5 were certain losses in the summer, leaving a potential crop of 13. Probably there were further reductions before flying time in late fall, and still others before the winter was over. What this means for perpetuation becomes more significant when one takes into account that breeding age is not attained until the fourth or fifth year.

In captivity: Mr. F. E. Blaauw, of Holland, secured five trumpeters over 30 years ago. Though he has been successful with them, his present stock consists of only 10, of which 5 are immature. In the past few years 12 of Blaauw's birds went to the Kellogg Bird

FIGURE 11.—Only the watchfulness of the parents deprived ravens of a feast on the four large eggs of this trumpeter swan nest. Photograph taken May 30, 1931, at Trumpeter Lake, Yellowstone, by G. M. Wright. Wild Life Survey No. 2353

Sanctuary at Battle Creek, Mich. It has not been ascertained that these have bred there.

So much for the general picture. What can be done to perpetuate and increase the trumpeter swan in Yellowstone Park? Report was received in 1929 that a pair on a small lake in the Lamar Valley had failed to raise any young in the four or five summers they had been observed. In the spring of 1930 the survey party found two nests—the one mentioned above and a second on Mirror Plateau. Each clutch was composed of six eggs. Yet there was but one living cygnet by late autumn.

Suspicion fell upon a number of possible enemies, but only one was convicted. A raven broke an egg in the nest on Mirror Plateau

and tried to fly off with the embryo. There were frequent raids by the ravens at the other nest, but they were successfully resisted.

Potential enemies of the cygnets were the coyote, otter, horned owl, eagle, and possibly even the badger. Coyote tracks were abundant around the margins of the lakes, and badgers lived all around. The entire swan families frequently took to the land to feed or to cross to near-by ponds, and they would be easy prey at such times. When the cygnets were small, an otter visited the Lamar Lake. Coots within 6 or 8 feet of the otter showed curiosity, but no fear, and were ignored in return. Neither was the swan family hurt. In the fall, when the cygnets were disappearing one by one, an otter family

FIGURE 12.—Shallow lake in the Bechler district in a dry season. Trumpeter swan nests may suffer the same fate as this beaver house. Photograph taken July 24, 1931, in Yellowstone, by G. M. Wright. Wild Life Survey No. 2292

came to stay in the lake for a time. Coot and ruddy duck remains were found in the feces, but no sign of a cygnet. The otters were not proved guilty.

One night in the following summer a member of the party slept at the very edge of the lake so that he might hear any unusual sound. In the morning one cygnet was missing. Horned owls were in the air that night, but this was not hanging evidence.

This season was a dry one. Several lakes reputed to harbor swans were found to be so low that even beaver houses were left dry. This suggests that in certain years swans attempting to nest on shallow waters may have their lakes vanish, or at least shrink until the nests are accessible to land enemies.

Winter status of the trumpeters was an open question because their movements after they were frozen out of the home lakes were not known. But during a cold spell early in 1932, 28 swans appeared on thermally warmed waters in the park. At the end of February the count totaled 41. This was good news, for, if the Yellowstone birds remain in or near the park in winter as well as summer, the hope of saving them is greatly increased.

The present indication is that the swans are at least hanging on. This permits of a little more time for intensive research to discover the critical factors during the periods of incubation, of raising the cygnets, and of absence from the breeding ponds in winter.

Many protective measures have been suggested, but it seems inadvisable to try much without better knowledge of the basic facts unless a tendency to further decrease becomes apparent. That would be an emergency justifying drastic action, such as removing all suspects from around the nesting lakes or raising a portion of the cygnets in semicaptivity where conditions could be definitely controlled. Measures in addition to the above which have been proposed are: Fencing coyote-proof lanes for swan travel between lakes, ranger detail to keep ravens cleared out during the incubation period, prohibition of entry to the breeding lakes by park visitors, enlistment of public support to wipe out the vandalism which is known to affect the swans when they are outside the park, and other suggestions.

The partial conclusions from investigations made to date are that whereas the trumpeter swan was decimated as the result of civilization's influence, and whereas the species may not be able to come back under ordinary park protection, it is desirable in consequence that there should be a program of careful study with a view to resorting to intensive management if further developments prove the necessity. This does not fail to recognize that low survival rate of cygnets may be normal for this species, inasmuch as the swan is long-lived and has relatively few natural enemies when full grown. But when the trumpeter is nearly extinct, it is important for as many cygnets as possible to survive, at least until such time as the breeding stock is restored to numerical safety. It is a case where special protection is amply justified as a temporary measure.

CONDITIONS CAUSED BY EARLY INFLUENCES OPERATING INDIRECTLY

Major influences responsible for injuring wild life indirectly were stock raising, agriculture, and lumbering. These human activities which affected the fauna adversely through altering essential elements in its environment have left behind them problems of very complicated nature. The ramifications of the upsets they caused are

FIGURE 13.—Adult trumpeters and six cygnets (one hidden in tules). The grown birds are powerful and capable of protecting their young in the water, but all are at a disadvantage on land. (Note rubber boat used by Survey in distance.) Photograph taken June 20, 1930, at Lamar River, Yellowstone. Wild Life Survey No. 880

FIGURE 14.—Two trumpeter swan cygnets from the same brood. Do young of the gray phase have a better chance of escaping enemies than those of the white phase? Photograph taken June 12, 1931, at Trumpeter Lake, Yellowstone, by G. M. Wright. Wild Life Survey No. 2268

great, and, consequently, difficult to disentangle. One of the worst influences, that of grazing, has not yet been completely eliminated. That is an objective which must be consummated at the earliest possible date. From the wild-life standpoint, an area is not a national park in fact until all domestic stock is permanently removed. The policy of not renewing permits when they expire seems to be the fairest method of meeting this situation.

But with the above exception, the original influences have been removed from the parks proper. The first step, then, in solving the problems which they have left behind them is to restore the altered environment to its original state, which was known to have been favorable to the species in question. Because this restoration may take a long time to accomplish, the species suffering may have to be sustained by a temporary program of assistance. If it is a case of a depleted range, the range itself may have to be temporarily protected against the animal until its grazing capacity is restored.

TO RESTORE A DEPLETED HABITAT (3)

It is hardly necessary to point out the close relationship between animal life and food supply. This refers not only to the grazing and browsing areas of the ungulates, but includes the food supply of every type of animal life; *i. e.*, if rodents and other forms of marten food have been destroyed, the marten's range is just as truly depleted as that of the elk when palatable herbage and browse are gone. And again, if wild life is managed along the all-too-thrifty and enterprising lines of a game farm, the range of the scavengers is apt to be empty. It is necessary that the trees be left to accumulate dead limbs and rot in the trunks; that the forest floor become littered; and that the wild life be left to prey upon itself in order that the range may not be destroyed for any species and that vigorous, healthy animals may be left in every niche.

Turning to the most obvious and important type of depleted food supply due to early conditions, we note especially that almost every range suitable for big game was overgrazed by sheep, cattle, and horses before 1900. In order to get some idea of the condition of the grassland ranges in their primitive condition, even when the great herds of buffalo and antelope roamed them, the following account from Coronado's explorations in 1540 through the territory now embracing the Southwest and prairie States is enlightening: "Who could believe that 1,000 horses and 500 of our cows and more than 5,000 rams and ewes and more than 1,500 friendly Indians and servants in traveling over these plains would leave no more trace where they had passed than if nothing had been there—nothing—so that it was necessary to make piles of bones and cow dung now and

then so that the rear guard could follow the army.”⁹ There was rank growth of the tall grasses then, whereas now the tall grasses are mostly gone, and even the short grasses are gone from many parts of the western range. In their places have come the unpalatable species that inevitably follow overgrazing. So that even where a range seems to be well covered, it may be with the unpalatable and undesirable types which leave little food for the game. This is the condition which exists in nearly all our parks to some extent, and especially in the Southwest parks and monuments.

Deer range in Zion Canyon.—In Zion National Park, the story as told by Ranger Harold Russell is essentially this: In 1909–10 about 3,000,000 board feet of yellow pine were logged off the east-rim country. Young pines are coming back, but the forest is replacing very slowly, as it does everywhere in this arid country. Mr. Russell said that forage conditions within the park are much better than they were formerly. The region had been grazed for 40 years before he saw it, and he was first at Zion in 1902. In the early days, settlers farmed the river bottom below Zion and up on the canyon floor. Owing to erosion started by overgrazing on the headwaters of the Virgin River, floods washed away the farm lands below, and they had to be deserted. Livestock, however, still ranged in the canyon. In 1915 a hard winter found the animals without feed. Every bit of forage was gone from the canyon. The settlers were forced to come up into Zion Canyon and cut down the cottonwoods so that their stock could eat the bark.

It is evident that conditions in Zion are much improved. Unfortunately, the watershed above the canyon is still badly overgrazed, and erosion and floods are taking their toll from the valley floor each season. But in the park itself, a thorough investigation of the range—degree of palatable forage, carrying capacity, etc.—needs to be worked out before large numbers of deer are allowed to come back. The same is true of Bryce, south rim of the Grand Canyon, the Indian reservations, the Guadalupe Mountains by Carlsbad, and of many of the winter-forage areas in the Rocky Mountain parks. Such areas should be lightly grazed for a number of years to give them chance to recover. Especially should horses be kept off these areas during the summer time in order to allow them to produce winter feed. The tendency to restore the ungulates at the expense of range and other forms of animal life should be guarded against for a number of years, thereby giving the range time to recover its normal carrying capacity. Unless this is done, the damage is apt to be permanent.

⁹ Castaneda's narration, "Relacion," Winship translation. Fourteenth Annual Report, Bureau of Ethnology, 1892–93.

**ABNORMAL ANIMAL POPULATIONS DUE TO EARLIER REMOVAL OF
NATURAL CONTROLS (4)**

Problems of this type that trace back to pre-park conditions are usually found to have been by-products of the stock-raising industry. Predatory animals, which normally controlled the undue increase of the wild ungulates, were eliminated to protect stock on the ranges and incidentally to provide more game for hunting. So long as they were open areas, the gun more than took the place of the predators, but the situation was reversed when they became parks. The large game increased without check until it further destroyed ranges which had already been impoverished by sheep and cattle. Worse than that, this unusual protection not only permitted the healthy animals to survive but also failed to take off the diseased and unfit, leaving them to reproduce and deteriorate the breeding stock. The local situation produced by an abnormal density of impoverished ungulates in conjunction with forage of greatly subnormal density and quality is like a bad fire hazard. All it requires is a bad season to precipitate a calamity. Only in one case the critical factor is a dry summer, in the other it is a snowy winter. In general, the solution of problems of this type is to be sought in the restoration of the natural control factor in environment. Yet in many instances this may take place so slowly that artificial control may have to be substituted as a temporary measure. Shooting for sport is unsatisfactory because it is selective of the finest specimens instead of the poor ones which, by rights, should be removed first.

Mule deer on north rim of the Grand Canyon.—This is a park question but, in its larger aspect, it is the Kaibab deer problem, which is so well known that it only needs to be mentioned here to serve as an excellent illustration.

Mule deer in Yosemite Valley.—Because the mountain lion was gone and other conditions altered, deer increased until the once famous wild-flower show on the floor of Yosemite Valley became a thing of memory, and even the brush was threatened with destruction. Deer were so common and so goat-like—having no need to be alert, and hence losing their charming wild behavior—that their interest to the visitor was greatly lessened. Crippled and diseased individuals which do not last long under natural conditions dragged around and added to the ugliness of the picture.

The first protective move made was to fence a few acres around the Ahwahnee grounds to preserve the plant life. This was not really compatible with national-park ideals.

Physically incapacitated deer were dispatched, and this helped one aspect of the problem.

A third measure was tried with success. Deer had been practically exterminated from the Tuolumne watershed in a successful campaign to stamp out hoof-and-mouth disease in 1924. Two purposes could be accomplished by transferring deer from Yosemite Valley in the Merced watershed to the Tuolumne drainage, and this has been done for several seasons, the method being to entice the animals into a corral, then load them on trucks for immediate release

FIGURE 15.—Deer are particularly fond of the flower heads of Evening Primrose (*Oenothera hookeri*). They did not overlook one in these three clumps, though the plants grew inside a supposedly deer-proof fence. Photograph taken July 20, 1929, in Yosemite Valley. Wild Life Survey No. 186

at the destination. The transplanted animals have not tended to drift back, so that the deer population of the valley is now more nearly within bounds.

Because a return of the mountain lion to the area is unlikely, due to the fact that all lions ranging in the park can be, and are, taken outside the boundaries, transplanting of deer may have to be more than a temporary measure of relief. However, throughout the park system the Service's policy of strict protection for predatory species is doing much to avert similar problems.

PROBLEMS OF GEOGRAPHICAL ORIGIN

FAILURE OF PARKS AS INDEPENDENT BIOLOGICAL UNITS

The preponderance of unfavorable wild-life conditions confronting superintendents is traceable to the insufficiency of park areas as self-contained biological units. In the present era of park development, this geographical cause ranks as the most important of the three major causes of wild-life problems. If the influx of visitors were to increase in the future at the same rate that it has in the past 15 years, competition between man and animal in the park could easily become more influential in faunal maladjustments than the geographical factor.

At present, not one park is large enough to provide year-round sanctuary for adequate populations of all resident species. Not one is so fortunate—and probably none can ever be unless it is an island—as to have boundaries that are a guarantee against the invasion of external influences. To all this the practical-minded will immediately retort that an area with artificial boundaries can never be a true biological entity, and obviously this is correct. But it is equally true that many parks' faunas could become self-sustaining and independent if areas and boundaries were fixed with careful consideration of their needs. Already many parks are being improved in this regard, and there is a vast amount more that can be done.

When all advisable enlargements and boundary corrections have been made, there will still be external influences and probably some range inadequacies to be reckoned with and some management measures will be necessary for the protection of the affected species. Whereas both general types of problems due to the inadequacies of parks as independent biological units must be met primarily by changing the boundaries, as the only means of dealing with the fundamental cause, success can not be as great in one instance as the other. By his action, man can restore a needed range to a park provided he is willing to do it, but there is absolutely no way he can keep every unfavorable influence out of that park—not so long as boundaries are artificial, and some of them must always be that.

CONDITIONS CAUSED BY FAILURE TO INCLUDE THE COMPLETE ANIMAL HABITAT

Unfortunately, most of our national parks are mountain-top parks. During the summer, game retreats to the higher elevations. With the coming of winter the game drifts down below the park, away

from protection. For a wild-life preserve this is obviously an unsatisfactory condition. It is utterly impossible to protect animals in an area so small that they are within it only a portion of the year. It is just as fundamental to protect the whole range of the resident fauna of any park as it is to protect the watershed of any stream for its water supply. One would not think of just protecting a narrow zone across which the water flows, but would extend the protection to the natural boundaries of the watershed. In like manner, it is useless to draw up imaginary and arbitrary boundaries for a park and expect to protect the animal life drifting through. This is exactly what has been done in creating the national parks—a little square has been chalked across the drift of the game, and the game doesn't stay within the square. In order that our parks may be able to adequately protect and preserve their wild life as part of our national heritage, it is essential that they be formed principally of natural boundaries, and not arbitrary boundaries. Natural boundaries in this case mean natural barriers limiting the range of the wild life concerned. While the natural boundaries are not definite lines, they are sufficiently tangible in character to be capable of practical establishment. It is now, perhaps, too late to establish natural boundaries completely around all parks, but that is no reason why they should not be established where it is still possible.

If natural boundaries are natural barriers limiting the range of the wild life of any particular area, more definite designation of what these natural barriers should be is necessary. The natural barriers are different for each park, and must be treated as individual problems in each case. But if there is any value in a generalization, this much might be said: As a natural barrier, a mountain crest is better than a valley or stream, but the lowest zone inhabited by the majority of the park fauna is probably the best of all.

All of the western parks are mountain areas. Some of them are a fringe around a mountain peak; some of them are a patch on one slope of a mountain extending to its crest; and some of them are but portions of one slope. All of them have arbitrary boundaries laid out to protect some scenic feature. But our national heritage is richer than just scenic features; the realization is coming that perhaps our greatest national heritage is nature itself, with all its complexity and its abundance of life, which, when combined with great scenic beauty as it is in the national parks, becomes of unlimited value. This is what we would attain in the national parks. In order to attain it, their boundaries must be drafted to meet the needs of their wild life. The entire complexity of wild life can be protected only within natural barriers. In establishing the boundaries, natural barriers should be followed.

Because so many of the national parks are in the high mountains, the seasonal habitat usually lacking is winter range. One exception where the reverse is true is Grand Canyon; but as it is such an uncommon case, it is discussed under that park only. Lack of summer habitat is not one of the major types of wild-life problems.

ANIMALS CUT OFF FROM WINTER RANGE (5)

Situations where park animals are suffering from lack of winter range must be met by extending the area to include the needed habitat if there is any possible way of doing so. There is an alterna-

FIGURE 16.—One of the meadows in Beaver Park frequented by the park elk and a necessity to them in winter. Photograph taken June 26, 1931, in Rocky Mountain. Wild Life Survey No. 1895

tive in management, but it is a poor expedient at best, having several unfortunate consequences of its own. Artificial feeding is expensive. Concentration at feeding stations is a potential for the spread of disease. There are unguessed possibilities for harm in pauperizing wild animals. Besides, holding game herds in the higher altitudes of deep snows exposes them unduly to carnivores. This means that additional management to protect them against the unnatural and excessive exposure to their enemies is required; and it is always undesirable to create a condition which necessitates interference with the predatory species in a park. The so-called northern elk herd in Yellowstone is an example containing all the elements of this type of problem, but it has been ably covered elsewhere by William

Rush¹⁰ in his 3-year study of this herd. Consequently, another example has been chosen for treatment here.

Elk range in Rocky Mountain.—American wapiti were so abundant in this section in early days that market hunters took them out in wagonloads. They were almost exterminated and were later reintroduced from Yellowstone. There are now believed to be approximately 350 in the area, and Rocky Mountain National Park is already faced with an elk problem.

Elk on the east slope require the grasses at the edge of timber and above for summer range, the forested middle slopes for protection and calving, and the open valleys lower down for winter range.

FIGURE 17.—The mouth of Black Canyon supports stands of antelope brush (*Purshia tridentata*), aspen, and other browse vital to elk and deer in winter. Photograph taken June 26, 1931, in Rocky Mountain. Wild Life Survey No. 2425

The present park has suitable area for the first two requirements, but none for the third, which is, of course, a critical one.

The eastern boundary is intersected by a series of open mountain valleys which are privately owned and therefore lie outside of the park proper. These valleys, including Estes Park itself, are the natural and only available winter range for the elk. They drift down into these parks in winter, destroying fences, gardens, haystacks, etc. Consequently, they are very much disliked locally. In harboring the animals the Park Service accepts a responsibility that they should not be a nuisance to the countryside. If the problem is not met squarely, and, as a result, the elk are looked upon as a

¹⁰ Final Report on Elk Study, Northern Yellowstone Herd, by Rush, W. M. Yellowstone Park, Wyo., 1932.

liability instead of an asset, both the elk and the cause of conservation will suffer.

The crest of the foothills just east of Estes Park would be the most nearly ideal natural boundary for the park; but for a long time to come the best that can be hoped for by way of a solution is to purchase the private holdings in the small higher valleys, namely, Moraine, Beaver, and Horseshoe Parks and Black Canyon. The program of enlarging this section of the park is being carried on at the present time. This is the first and most important step in the solution of the problem, but it is by no means the last. The meadows in these parks have been heavily grazed by domestic stock, mostly horses, for years. As the lands are acquired, a range-management plan is being formulated for the restoration of the range to its former high carrying capacity.¹¹

During the winter of 1930 aspen was extensively barked by the elk. This was the first indication that the elk herd was reaching the limit of its food supply and that range abuse and starvation were in the offing. If this is happening when there are only 350 elk in the park, it is indication that even with the addition of the valleys above mentioned there will be a definite limit to the population of this species that Rocky Mountain National Park will be able to support without endangering both park and elk. The situation will have to be carefully watched, and increase beyond the allowable maximum checked if natural balances are not effective.

To sum up, this problem is caused by failure of the park to include all the seasonal habitats of the elk. The basic cause will be largely corrected by extension of boundaries to include winter range. This will have to be followed, as a second step, by a temporary range-management plan to restore the vegetative cover on the added lands to their vigorous primitive condition. Beyond that, a third step in the form of artificial control may be necessary if the elk continue to increase without reaching a natural balance. Within an area as small as Rocky Mountain Park it is unlikely that a natural balance can be established, hence the excess above a safety point will have to be disposed of in some way.

CONDITIONS CAUSED BY EXTERNAL INFLUENCES

The extent to which the fauna of any particular park suffers from adverse external influences depends upon three factors, namely:

(a) How much the fauna in the surrounding territory has been altered from its primitive condition.

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¹¹ Report on Conditions of Portions of Elk and Deer Winter Range in Rocky Mountain National Park, by McLaughlin, John L. Rocky Mountain National Park, Colo., Jan. 15, 1932.

FIGURE 18.—Aspen barked extensively by elk for the first time indicate that shortage of winter forage is beginning to be felt. Photograph taken June 24, 1931, at Fall River Lodge, Rocky Mountain. Wild Life Survey No. 1928

(b) How adequate the area of the park is.

(c) How nearly the park boundaries follow natural barriers.

Every park is surrounded by territory in which the wild life has been greatly changed, but in some cases the aridity of the faunal life in such regions has become so great that the vitality of the park fauna is sapped at every boundary. Inasmuch as the external factor itself can not be generally controlled, resort must be had to improving the other two conditions. Increasing the size of the area and bounding it by natural barriers will help in many cases, but some encroachments, such as the spread of certain exotic plants or animals

FIGURE 19.—River otter is one of the fur-bearers that can only be perpetuated in parks of large area. There are few places where the otter trusts man enough to play in the waters of a small lake while people watch from shore. Photograph taken July 10, 1931, at Bear Paw Lake, Grand Teton, by B. H. Thompson. Wild Life Survey No. 2424

into a park, can not be stopped by any of these methods. Management measures to counteract these influences may be worked out in some instances, but there will be others where nothing that can be done is likely to correct matters.

CARNIVORES DRAINED FROM PARK BECAUSE BLACKLISTED OUTSIDE (6)

As regards their faunas, the parks stand in a peculiar relationship to the surrounding regions. Local residents in one breath praise the park as a breeding refuge for game to stock the countryside and in the next condemn it as a nest for the predatory species which they call vermin. The park standpoint is quite different. It has a special duty to protect the carnivorous forms which are blacklisted

everywhere else. Game species do receive some consideration elsewhere, but the carnivores are insistently destroyed.

The draining away of the normal predator population is a more complex problem than just the loss of a member or two of the native fauna. It involves the danger of an abnormal increase in the ungulates which, in turn, involves abuse of the flora, and so on.

Because of their wide ranging habits and greater scarcity per unit area, it is relatively easy to almost completely deplete the smaller parks of these blacklisted species. Consequently, solution of this type of problem is to be sought in enlarging the size of the park. As the predators are generally less restricted by natural barriers, little can be done for them by merely changing boundaries without greatly extending the protected areas. In the case of mountain lions and wolves, especially the latter, it is doubtful if there is at present any park large enough in which they may be saved. The mountain lion is tenacious and may hang on in this country for a long time, but the wolf is already close to extermination. There is little likelihood that protection would be granted to wolves in areas adjacent to the parks, so they probably will go entirely. The coyote, on the other hand, prospers in spite of man and does not constitute a problem in this regard. Some of the smaller carnivores, including many fur-bearers, such as wild cat, fisher, wolverine, badger, otter, etc., may be saved by enlarging the parks and perhaps by providing some other protective management measures.

Wolverine in the parks of the United States.—As the example selected for problems of this type, the wolverine can be best treated by considering its status in all the parks of the United States in which it was a native. Comprehension of this question depends upon appreciation of the relation the parks bear to the status of the species as a whole.

Among our animals the wolverine is one of the most unique and interesting. On the other hand, it has been one of the most persecuted because of its fur value and also because of its annoying habit of robbing trap lines. This persecution continues in the areas surrounding the parks where wolverines are still found and, owing to their wandering habits, keeps them drained away so that they will soon disappear from these last stands.

According to records of past conditions, the wolverine was never so abundant in the United States as in Canada, being restricted to the higher life zones. It is almost gone from this country now. There are a few wolverines in Sequoia National Park (estimate of nine in superintendent's 1931 report), perhaps more than in any other of our western parks. The wolverine of Sequoia is a different species than the Canadian wolverine. In Yosemite, Grinnell and

Storer report the capture of two wolverines at the upper end of Lyell Canyon in July, 1915. At several other places in the park, tracks were seen which they ascribed to wolverine.¹² In July, 1929, a wolverine track was seen in moist sand near Saddlebag Lake, just outside the boundary, by our party.

There seems to be no indication or record of wolverine in Lassen Volcanic or in Crater Lake National Parks. At Mount Rainier tracks of wolverine are occasionally seen. October 3, 1930, our party saw tracks of wolverine on Burroughs Mountain, by Sunrise Park. In Glacier National Park, Vernon Bailey¹³ reports a few trapped and killed at various places in the park between the years 1895 and 1910, but doubts whether any are present now, although he stresses the possibility of their wandering in from elsewhere. In the Yellowstone-Teton region, a few wolverines may still be present. They have been trapped outside of the parks, and occasionally tracks are seen. In Rocky Mountain National Park they were present in moderate numbers during the pioneer days of that region, but none has been seen in or near the park for many years, and they are believed to be gone from the region.

The foregoing data give a general picture of the present status of wolverines in those western parks where they should naturally be. It is evident in each park that their numbers have greatly decreased, this decrease being primarily due to trapping, the direct agency of man.

What can be done? There are several things which would help the wolverine to come back.

(a) Consciousness of the problem is the first step. Without being aware of the plight of our fauna, nothing could even be tried.

(b) Since wolverines are great wanderers, it would be well to consider the requirements of their range in establishing or completing boundaries. Enlargement of park areas in the upper Canadian and Hudsonian zones would increase their chances greatly.

(c) As most of the parks concerned could not be made large enough to be ideal in this respect, a protective zone, free from all hunting and trapping, might be established around each park as a further safeguard.

(d) Special attention could be paid to the matter of protection from poaching for this and other species known to be in danger. This does not mean that the parks are not patrolled; it merely means that an added emphasis should be placed on protection in these cases.

¹²Animal Life in the Yosemite, by Grinnell, Joseph, and Storer, Tracy I. University of California Press, Berkeley, Calif., 1924, pp. 85-86.

¹³Wild Animals of Glacier National Park, by Bailey, Vernon, and Bailey, Florence Merriam. National Park Service, U. S. Department of the Interior, 1917, pp. 90-91.

(e) If all means of encouragement and protection should fail, then in some instances it might be possible to procure and liberate a few pairs for breeding stock. This would be especially desirable in the Rocky Mountain parks, where the common wolverine (*Gulo luscus*) could be planted. In the Cascade-Sierran parks, no introduction of stock should be even considered until the ranges of the common and southern (*Gulo luteus*) forms are more definitely worked out. If an intergradation of these two forms should occur in this region, it would be especially valuable, scientifically and educationally, to do nothing that would disturb this natural blending of species. If the wolverines in this area should continue to decrease, then it might be justifiable and necessary to choose breeding stock from the nearest range of the native species for reintroduction into the parks concerned. The feasibility of trapping and transporting wolverines has been demonstrated in the securing of a number of these animals from Alaska for the zoological gardens at St. Louis, Mo.

ENCROACHMENT OF EXOTIC SPECIES UPON THE NATIVE PARK FAUNA (7)

This is a situation which is not apparent in many parks at present, but which is apt to become more and more difficult. There are three ways in which man has brought about the introduction of exotics.

(a) Many imported species of animals, notably game birds and fishes, are liberated all over the country each year in the interests of sportsmen.

(b) Exotic species are constantly being liberated by accident.

(c) Certain animals native to one part of the country actually flourish with civilization and invade new ranges in the wake of man. These are exotic in their newly occupied ranges, too.

If any animal introduced by any of the above means takes hold and spreads into a park, serious complications are bound to ensue, for such an animal would not increase if it were not able to displace another form or compete successfully in the utilization of a valuable food supply. Aside from the direct competitive effect, such introductions may have indirect influences, such as disease introduction and production of crossbreeds, but these are treated separately below.

Fortunately, most of the foreign game introductions have not been notably successful. However, captive animals which are liberated, perhaps accidentally, and do take hold are a real danger. Their vigorous adaptive qualities are a menace to native wild life. The opossum, which has recently arrived in Sequoia National Park, is an example. The same is true of the animals which thrive and spread where man goes. They are exceptionally adaptive and aggressive, or they would not have been able to go with him. Certain ground squirrels and the coyote are notable examples.

Effective ways of dealing with this type of problem remain to be discovered. The size of a park is of no avail and such species do not recognize many natural barriers. It is to be hoped that some practical means of preventing encroachments will be found before it is too late.

Coyote in Mount McKinley.—The spread of the coyote is a difficult and insidious problem. The reasons for its sudden spread over vast new territories are too controversial to be discussed here, but this outward movement is certainly associated with the changes which human populations have wrought. In Mount McKinley National Park its invasion is looked upon with great alarm.

Regarding the spread of the coyote, E. A. Goldman¹⁴ says: "Formerly they occupied the western plains and basal mountain slopes from western Canada and the United States south over the tableland of Mexico, and the tropical savannas along the Pacific coast as far as Costa Rica . . .

"In recent years coyotes have pushed northward, however, from British Columbia and Yukon Territory into the Yukon Valley and are reported to have reached Point Barrow, Alaska, and the mouth of the Mackenzie River in Canada . . .

"According to a resident of Telegraph Creek near the Stikine River, Canada, no coyotes were known in that section prior to 1899 . . .

"The movement into new territory evidently began in early days. Vernon Bailey states that coyotes were absent from parts of southeastern Minnesota prior to 1875 when they first appeared in Sherburne County, presumably from the great prairies west of the Mississippi River. When they became common, the red foxes, formerly numerous, practically disappeared . . .

"Coyotes entered the upper peninsula of Michigan about 1906, and have even gone into forested sections near the coast in Oregon . . .

"They are also being reported from localities east of their former habitat on the western plains. . . . Small colonies are reported in western, central and southeastern Alabama."

In his field notes, Dixon reports the skull of a coyote which was killed at Mount McKinley Park in 1926. Since that time the coyote has been gradually encroaching on the park. Similar experiences elsewhere indicate that it will tend to displace the abundant Alaska red fox, and perhaps the wolf, too, in the only national park where that animal still figures. The effect of a new and formidable enemy upon ptarmigan, curlew, mountain-sheep lambs, caribou calves, etc., can only be conjectured.

¹⁴ The Coyote—Archpredator, by Goldman, E. A., *Journal of Mammalogy*, Vol. XI, no. 3, August, 1930, pp. 327-329.

Mr. Stokley Ligon's analysis of the problem, which applies here very well, is essentially this: The coyote is beneficial in its own range and habitat; but when it gets outside of its own range, as it has done many times, it becomes a different animal and is destructive.

First of all, it is the aim of the National Park Service to maintain primitive conditions in the national parks. If this is to be accomplished, the coyote, where it is native to the park (it is clearly *not* native to Mount McKinley), has as much right as any other member of the park fauna. It is to be considered just as worthy and desirable as elk, moose, or deer. Indeed, when it is seen, it is a great attraction. There is sometimes a tendency in men in the field to hold any predator in the same disreputable position as any human criminal. It seems well to comment that no moral status should be attached to any animal. It is just as natural (just as much a part of nature) for coyotes to prey upon other animal life as it is for trees to grow from the soil, and nobody questions the morality of the latter. This is one angle of the situation.

The other side is that in relatively small areas, such as Mount McKinley and Yellowstone, where the wild life is of greatest importance, it is impossible to preserve that wild life and allow the encroachment of exotic predatory species or of abnormal numbers of the native ones from the outside. The antelope and mountain sheep of Yellowstone could be easily exterminated and the loss would be great, whereas the coyote is of such wide distribution that its extermination in Yellowstone is not probable. Even if it were exterminated in that particular area, it would soon reinvade. Actually it is remarkably abundant, though some control work is carried on.

The logical course of action seems to be this: If coyotes are present in a park in greater numbers than formerly but give no indications of unusual damage, they should not be molested. We do not know enough about the causes of their increase yet to justify steps against it. In Mount McKinley, where the animal life is of great importance and where the coyote does not belong, every safe step should be taken against its encroachment as an exotic and an alien. In Yellowstone, where certain species such as antelope, mountain sheep, trumpeter swan, and sandhill crane need special protection, the coyote must be controlled. Mount McKinley and Yellowstone are at present the only parks where circumstances clearly justify coyote control.

Inasmuch as there is no way of preventing the invasion of the park at the boundary line, the word control is used advisedly. It is the only way to meet the coyote problem. The solution could be a satisfactory one if there were any practical selective method which could be used. Shooting is selective, but it is costly and not sufficiently effective for the coyote. Trapping is the next best. It is effective

but not selective. In Mount McKinley the prized foxes and wolves, as well as wolverines and others, would suffer, too. Poisoning, of course, could not be allowed. It would be better to have the coyote. When a satisfactory method for taking coyotes without harming anything else is discovered, one of the most puzzling of all wild-life problems will be solved.

DILUTION OF NATIVE STOCKS BY HYBRIDIZING (8)

The distribution of vertebrate life and correlation of speciation with geographic range is one of the most fascinating of zoological studies. The ranges of some forms were not even worked out before those animals were exterminated. This is true of the grizzlies. So many of the grizzlies are extinct that the taxonomy of the species will never be fully known.

But this is only part of the story. There is a great and growing tendency to transplant animals from one part of the country to the other without any regard to the native range of each form. This means hybridization of one subspecies with another and a gradual muddling until many forms are lost.

In the national parks it is especially desirable to preserve the pure native strains. This can not be done if related subspecies of the park animals are introduced in adjacent territories, and consequently the only solution for problems of this type is to seek for a reform in restocking practices. The only way to secure protection would be to designate a Federal commission or agency through which all stocks for transplanting purposes would have to be cleared.

Elk transplants from Yellowstone.—This needed reform in restocking practice might well start with the National Park Service itself. The elk of Yellowstone (*Cervus canadensis canadensis*) have been planted widely within the range of the other species and subspecies of this animal. There are Yellowstone elk in Rocky Mountain, Mount Rainier, Crater Lake, and the Guadalupe Mountains by Carlsbad. At the time the Yellowstone elk came to Rocky Mountain there were probably still native elk in the park. While it is true that they were supposedly of the same species, nevertheless any possibility of studying intergradations or races which might have existed is now lost. The Yellowstone elk in Mount Rainier have drifted in from the Cascades east of the park.¹⁵ Probably the original elk of Mount Rainier were the Roosevelt elk, and therefore any reintroduction should have been of this species. If there were ever elk in the Guadalupe Mountains, they were probably the Merriam elk, a southwestern species now extinct. In any event, there would be little

¹⁵ Mammals and Birds of Mount Rainier National Park, by Taylor, Walter P., and Shaw, William T. National Park Service, Department of the Interior, 1927, p. 116.

value in having Yellowstone elk down in the Guadalupe. There are many who believe that the educational value of seeing an animal lies in the significance of that animal's relation to its environment and past history. When the species are mixed or replaced, there is nothing left but just another elk.

The purpose of this discussion is to bring up the question of Park Service policy on shipping breeding stock to alien localities. It so happens that none of the elk plants discussed above was made in the parks where the elk now exist. But they were distributed in response to outside requests. Because of their proximity, they drifted into the parks, and the results were the same.

The situation seems to indicate that the Park Service, in order to protect its different faunas, would be justified in establishing the policy of shipping animals only to points within their native range (museums and zoological gardens, of course, excepted).

Caribou and reindeer in Mount McKinley.—This is a striking illustration of the danger that an outstanding native park animal may be lost through hybridization with an exotic variety introduced in the surrounding region.

Ten reindeer from eastern Siberia were introduced into Alaska in 1891. By 1902, 1,280 reindeer had been imported. To-day these animals number about 200,000 in Alaska. Being very closely related to the caribou, they hybridize readily; so that the future status of the caribou is questionable. The reindeer industry has spread eastward across Alaska until reindeer are now at Broad Pass, just outside of Mount McKinley National Park. The caribou of Mount McKinley are one of its great values. While the Mount McKinley caribou are separate from the main caribou migration in the north and east, they are nevertheless a considerable band, of about 50,000, with a local seasonal migration, and they are so situated as to be on the reindeer frontier unless some measure is taken to keep reindeer away from the Mount McKinley area. In 1926 Dixon and Wright saw reindeer, caribou, and hybrids in the park. Now, with the stated aim of the industry to hybridize caribou and reindeer and the natural tendency for this hybridization to occur anyway, it becomes increasingly valuable to maintain the Mount McKinley caribou as a pure strain. The Park Service, the Biological Survey, and many others recognize this situation and are trying to prevent its unfortunate consequences. Whether anything can be done to save the Mount McKinley caribou, ultimately, is a question.

Aside from hybridization or driving out native forms, the great danger in all such introduction of exotics lies in the possibility of bringing in some pest or disease which would prove fatal to the native species. No reindeer plagues have occurred in Alaska yet, but we do not know the potentialities.

EXPOSURE OF NATIVE SPECIES TO DISEASES AND INFLUENCES
OF ALIEN FAUNAS (9)

One of the fundamental principles governing the distribution of animal life is that when the faunas of two different continents meet, the fauna of the larger continent will be the survivor. There is abundant paleontological as well as present-day evidence substantiating this fact. When we bring domestic stock, particularly sheep and cattle, in contact with native game, we are exposing the native game to members of the Asiatic fauna. This brings in new diseases and new conditions with which the native fauna has not had to cope before, and the results are apt to be disastrous.

All livestock and wild game are subject to many different diseases and parasites. If an outbreak occurs in domestic stock, there are chances of its being controlled. If it gets into the native wild life, it is apt to run its course, with irreparable damage. There is one important exception to the foregoing statement, and that is the control of the hoof-and-mouth epidemic among deer in California, 1924. The plague was stamped out by killing 22,214 deer. But it is obvious that any such remedy would be fatal to mountain sheep, mountain goats, antelope, elk, moose, or any other rare forms of animal life.

It is not actually necessary for domestic stock and native game to come in contact for the damage to be done. Even use of the same range may be just as effective, for some of the most viable disease germs may be carried in the soil for years to start a new outbreak.

Because of the above circumstances, it is clear that the only way to treat problems of this type is to prevent possibility of their occurrence. This can be accomplished for species occupying a restricted range by keeping domestic stock out of a neutral zone between the two. This would work with mountain sheep or antelope, but not so well for deer or elk. Fortunately, the rarer species are the ones to which it is most feasible to extend this sort of protection.

Where a disease has already been contracted by a park animal there is but little that management can do so far as is known at the present time. The first step is to adjust the park boundaries so as to prevent reinfection through the same avenue. The spread of disease may sometimes be checked by destroying carcasses of infected animals. In another case the disease might be eliminated by destroying the alternate host where that host was not a rare form and could be counted upon to reinvade the territory later on when the disease had been conquered.

Sheep scab in Rocky Mountain.—There is some dispute concerning whether the wild sheep of America were subject to sheep scab before the introduction of domestic sheep, but the evidence seems to point to the fact that they were not. Numerous accounts tell of

heavy losses of mountain sheep from sheep scab in the pioneer days of the sheep industry in the West. Merritt Cary¹⁶ says: "A danger which threatens mountain sheep in Colorado, as well as in other Western States, is the introduction of scab from domestic sheep allowed to graze on the higher mountain slopes." Warren¹⁷ says: "C. F. Frey tells me they suffer much from scab in the West Elk Mountains, and that a party told him in 1902, at one place near the head of Sapinero Creek, 75 head were counted which had died of scab. Domestic sheep had been run in that locality, and the wild sheep doubtless contracted it from them."

Aside from the question of origin of the disease, the fact remains that whereas domestic sheep may be treated and cured of sheep scab, there is no known way of dealing with it in mountain sheep. When the survey party was in Rocky Mountain in 1930 and in 1931 the mountain sheep were scabby. Reports of local residents indicated that scab had been present for many years, being worse in some periods than others. Domestic sheep had been run in these mountains for so long that it was not possible to determine definitely that the wild sheep were not subject to an endemic form of sheep scab.

The sheep situation in Rocky Mountain should be investigated thoroughly. In the meantime reinfection should be prevented by removing the domestic sheep as far as possible from the mountain-sheep range. The Never Summer Mountains addition has already been an improvement in this regard.

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¹⁶ A Biological Survey of Colorado, by Cary, Merritt. North American Fauna No. 33, 1911, p. 62.

¹⁷ The Mammals of Colorado, by Warren, Edward R., 1910, p. 238.

PROBLEMS OF COMPETITIVE ORIGIN

CONFLICT BETWEEN MAN AND ANIMAL IN THE PARKS

Since he is in the parks permanently both as resident and seasonal visitor, man must henceforth be considered an integral part of those microcosms. The significant difference between himself and all other ecological factors is that he is conscious of his relationship to the other elements of the park world and hence can regulate, or at least modify, his influence to suit his own purpose. It happens that in the parks the purpose dominating man's relations to his environment is the maintenance of all the animal and plant life in an unmodified wilderness state. In order not to defeat his own ends, he contrives that his presence shall disturb the wild life to the very smallest degree that his ingenuity can manage.

This means that painstaking consideration for the welfare of the fauna must accompany the development of every phase of human occupation of the parks. Yet developments in the era just closed have not always been characterized by as much restraint as a delicate situation required. This was only natural in a time when the principal preoccupations were making the parks accessible, attracting the visitors to them, and making them comfortably at home while there. But in the era opening ahead, the critical faunal maladjustments that have already been created, as well as those just raising their heads, must be dealt with in a farsighted manner. For if the wild life continues to give back before the growing pressure, man will presently find that he has unwittingly destroyed the very thing which he came to the national parks above all other places to enjoy.

In considering the effects of man's intrusion in the total environment which is the park, it is apparent at once that certain faunal complications are inevitable, if for no other reason than the quantitative displacements which must take place. These problems are rooted in the conflict of the more fundamental needs of man and animals in the parks. As their cause is man's presence and that presence is not only continuing but constantly increasing, they must be treated accordingly. These problems are essential by-products of the sharing of a common habitat by man and animal.

There are other complications, however, which are not caused so much by man's actual needs as by his ideas of what wild animals are and how he should see them. Inasmuch as these are problems caused by human concepts which can be changed, they are subject

to control at their sources. It is necessary to analyze these problems to fully realize that they arise from man's efforts to force the animal life to actually fit his concept instead of developing his concept to fit the wild life as it really exists in its natural setting.

These difficulties are more truthfully problems of human nature than of animal nature. In dealing with them it becomes necessary to enter the fields of philosophy and psychology, because, after all, the national parks are an experiment in these fields. Wherever he goes, man unconsciously tries to surround himself with the things to which he is accustomed. He abhors change. Consequently almost any labor in transplanting whole environments is found preferable to the effort of reconditioning to new circumstances and concepts. Coming from the city, man tries to approximate in the park the conditions he left behind. If his eye is met by a planting of his home flowers arranged in garden pattern, he praises it as a beautiful improvement unless his viewpoint has been reeducated to an appreciation of the park's own distinctive wild gardens, and then it becomes a jarring note on the landscape.

Generations ago man was accustomed to wild animals, but that has all been buried in city life. Whenever he has seen wild animals at all, they have been presented in some way compatible with dense populations. When he enters the park he is looking for the same concentration of animals he saw in the paddocks of the zoological garden, the same personal safety in feeding the tamed animals, the same convenience of driving to a known place at any convenient time to see what he wants. A galaxy of bears at the garbage platform approximates this concept and he is satisfied. Then comes a day when his heart skips a beat. Walking along a deep forest trail he comes upon a single bear eagerly peeling the bark from a log in search of fat white grubs. This is a fresh thrill and it brings the realization that the unique charm of the animals in a national park lies in their wildness, not their tameness, in their primitive struggle to survive rather than their fat certainty of an easy living. The new concept involves an appreciation of the characteristics of a real wild animal, notably, that each wild animal is the embodied story of natural forces which have been operative for millions of years and is therefore a priceless creation, a living embodiment of the past, a presentiment of the future. It teaches the new joy of seeking out the wild creatures where they are leading their own fascinating lives instead of having them pauperized in camp where each individual animal becomes a bull in a china shop.

The change from urban to wilderness concept of the presentation of wild life will remove the cause of many wild-life problems. The Service has developed an educational branch dedicated to this

FIGURE 20a.—Black bears congregated at a feeding station are spectacular but the scene does not typify the finest park values. Photograph taken September 11, 1929, at Canyon Lodge, Yellowstone. Wild Life Survey No. 448

FIGURE 20b.—A single bear feeding naturally on grass in a glade presents a more pleasing and, because of the wildness of the whole setting, a more thrilling picture. Photograph taken June 21, 1930, at Crescent Hill, Yellowstone. Wild Life Survey No. 962

very task of bringing to man a true appreciation of national-park values; and as its work becomes more and more effective, it will remove the desire to improve wild life where such improvement is detrimental not only to the fauna but, in the last analysis, to man's interests as well.

In the following treatment of some of the major types of problems it is granted that the actual maladjustments exist. Whether they are problems which could have been avoided or not, they all must be faced. It seems best to deal first with species which actually interfere with human occupation.

ANIMALS HARMFUL TO MAN

A very few park animals are dangerous to human life. A few more are merely offensive. More often, animals are injurious to property or to some special landscape feature needing special protection. In nearly every instance the damage occurs only under certain conditions and no species except certain poisonous reptiles are to be considered dangerous at all times. Whenever it is necessary to act at all, man's retaliation should be governed by a full realization that his ultimate interest in the park is best served by preserving its fauna intact. Therefore, first and always, some means should be sought which will give protection against the damage without hurting the status of the animal which caused it. If fish-eating animals, woodpeckers, bears, deer, elk, beavers, skunks, wood rats, and others were destroyed whenever they were a nuisance, the parks would be comfortable surely, but they would resemble city, more than national parks.

UNUSUAL DAMAGE TO LANDSCAPE (10)

In general, the normal utilization of vegetation by the herbivores is no concern in administration. There are exceptions, however. These occur in two cases.

(a) Certain trees and shrubs growing naturally may be located at strategic points which make them individually so valuable to man's interest in the park that his interference to prevent their destruction is justified.

(b) Where man has resorted to planting to restore a landscape which he has defaced, protection of the newly set trees and shrubs often becomes necessary, as they are particularly subject to attack by animals.

The more planting that is done in a park the more faunal complications there will be. This is an additional argument for keeping artificial landscape planting in national parks to the minimum. Some landscaping is essential in order to reestablish the native

FIGURE 21.—White fir in the Hotel Ahwahnee grounds, Yosemite Valley, heavily browsed by deer. Trees and shrubs transplanted for necessary landscaping purposes have to be temporarily protected against such depredations. Photograph taken March 29, 1930. Wild Life Survey No. 562

FIGURE 22.—Piñon girdled by porcupine. Note bark chips on the ground. Except in particular locations, such as this at the foot of Cliff Palace where large numbers of trees have been ruined, the value of the porcupines is greater than that of the few trees killed by them. Photograph taken November 10, 1930, at Cliff Palace, Mesa Verde. Wild Life Survey No. 1537

cover destroyed in the construction of buildings and roads. This applies not only to new projects but also to eradication of scars where an old road or building area is abandoned. Transplanted vegetation is in a precarious condition until it becomes established in the new location. Because it is more succulent than the older forage, and perhaps for other reasons as yet not understood, it is apt to be demolished by deer, elk, rabbits, squirrels, porcupines, and other herbivores.

The proper approach to problems of this type is to anticipate the damage in any locality by choosing the less palatable species, using sufficient seed or stock to allow for an estimated loss, or planning whatever else can be done toward meeting the difficulty from the botanical angle. It is to be hoped that the future will develop a useful management practice of this type.

The second way to meet these problems is by seeking some method of protecting the vegetation from attack. Temporary screening or fencing is expensive and incongruous on wild landscape, but it may be permitted in exceptional instances, say for a period long enough to establish shrubbery or trees in administrative centers. If rapid-growing species are used, the plants will soon be above browsing height or sturdy enough to stand full exposure.

Considerable experimental work has been carried on to discover repellents. Napthalene bags hung among the branches are said to be successful in deterring deer, but this is still in the experimental stage. Fish oils and other sprays have been tried, but these wash off quite readily.

The third possibility, and absolutely the last to be considered, is destruction of the individual offending animals. In a park, the larger vertebrates are usually prized above all other forms of wild life. Hence to kill an animal to save a plant is likely to be a cure more awful than the disease. If a careful consideration of all factors reveals that it actually will be a benefit to the whole of the park to remove the destructive animals, the usual precautions should be exercised in taking only the individual offenders and not risking the status of the species.

The discussion thus far has been limited to instances where the fauna was normal and the flora abnormal. But the problem may also be due to an abnormal faunal condition. Such is the case where the ungulates are unnaturally abundant, and this takes place frequently in the very population centers where landscaping is most necessary. The floor of Yosemite Valley is an excellent illustration of this. In such instances, the remedy of the situation lies first in restoration of the normal range-fauna relationship—a question treated elsewhere in this section.

FIGURE 23.—Cliff Palace piñon gnawed in 13 places. Trees like this, not actually girdled by the porcupine, are so weakened that they succumb to disease or insect attack. Photograph taken November 10, 1930, in Mesa Verde. Wild Life Survey No. 1538

Porcupine in Mesa Verde.—This is chosen for a specific example of animal injury to landscape because it involves both classes of such damage; namely, to natural growth of woody plants having an unusual value to man, and to plants transplanted for landscape improvement.

In the past few years porcupines have increased until their population is far above normal for the mesa. Such infestations of this species occur from time to time in various parts of its range from causes which as yet are unknown. Most unfortunately for man in

FIGURE 24.—The piñon grove is an essential part of the Cliff Palace picture, and this natural growth is necessary in checking erosion on the steep slope which supports the ruins. Photograph taken November 10, 1930, in Mesa Verde. Wild Life Survey No. 1607

the park, porcupines have congregated in the moist draws, destroying piñon pines that are of particular value to the essential interests of Mesa Verde as a national park.

One instance is in Cliff Canyon, directly below Cliff Palace, which is the major one of the ruins. By 1930, porcupines had barked the trees in this fine stand of piñon to the extent that many of the trees had died. There were 240 piñons in the area, over 150 of which had been damaged. It was estimated that one-third of the stand was already doomed, and the abundance of fresh gnawings pointed to the practical destruction of the entire grove in the near future.

The picturesque and natural setting of the Cliff Palace was definitely impaired. Furthermore, any destruction of the natural cover on the steep canyon slope immediately underneath endangers the preservation of the ruin by increasing the erosion. The cliff dwellings are the one and only reason for the establishment of Mesa Verde National Park and are to be protected above everything else on the mesa. At this location, the decision to remove a number of the porcupines was determined by the archeological values at stake.

FIGURE 25.—The porcupine discovers someone coming up the trail behind it. One of the most interesting of wild creatures, it should not be controlled in any park except in a most extreme case. Photograph taken August 19, 1931, at Rogers Lake, Glacier. Wild Life Survey No. 2384

The porcupine wave created a second problem in Upper Soda Canyon near scenic Park Point on the entrance road. Piñons are very scarce at this end of the mesa, so that certain individual trees have a great landscape value. Considerable effort has been expended to save those taken from the right of way on the new road by transplanting them to heal the old road scars. In the draws along the road at this point, the concentration of porcupines was rapidly eliminating both old and young trees, so that with the passing of the ancient and picturesque weather-scarred veterans there would be no second crop to replace them. Rather than lose trees which it cost a great deal to transplant and others which were preserved with great care when the road was constructed, it seemed preferable to remove the marauding porcupines.

Control work in both instances was accomplished by shooting the porcupines just at those points. In this way no other species was

involved and an exact check could be kept on the number of animals taken. Not the slightest chance was taken that the porcupine would be eliminated from the fauna of the park as a whole. Further, the species dealt with was not one in any danger of becoming extinct.

CONFLICTS WITH FISH CULTURE (11)

Fishes constitute the only wild-life resource which is harvested in the national parks. Because of this, the administrative relations involved have a unique aspect. Wild flowers are to be enjoyed in

FIGURE 26.—The osprey nest on the east entrance road attracts the attention of thousands of park visitors. The toll in fish is made up many times in the enjoyment this bird brings to all classes of visitors, including the fishermen. Photograph taken June 10, 1930, in Yellowstone. Wild Life Survey No. 603

place and the timber in the trees is not to be utilized. No animal is hunted, and only the fish is angled from its native waters. Fish culture is practiced to prevent depletion and to extend the pleasures of the sport to waters not naturally stocked.

It is not the intention here to question the merit of this important exception to general policy, for, admittedly, the direct benefit to man overrules the disadvantages which are incidentally incurred. However, it seems fitting to pause, before taking up the faunal complications involved, long enough to register a plea that in each park one watershed shall be set aside for the preservation of the aquatic biota in its undisturbed primitive state. In these areas there would never be any planting of fish or fish foods, and fishing would be carefully regulated so as not to deplete the breeding stock. The

time is rapidly approaching when these would be the only places on the continent where the native trout could be seen and studied in their primitive haunts unmodified by human influence.

Perhaps the immense value of preserving certain wilderness waters can be best emphasized in the recounting of an incident which took place some years ago. It happened on the occasion of a pack trip in the upper Kern Canyon, California. A member of the party who was a prominent citizen of this country was about to fulfill a lifetime ambition to catch golden trout in its native stream. He had traveled nearly 3,000 miles and tramped a few more weary ones expressly for this purpose. This man was no ichthyologist, merely a devotee of Izaak Walton who had sampled noted trout waters in all parts of the earth.

On a bright morning one of the writers scrambled up the steep walls of Volcano Creek with the one who was going to realize his dream of gold. But surprisingly enough, he chose to take only two trout. They were laid side by side on the green bank, turned over and over, admired and carefully compared. Fishing was good, but why steal more from this precious source when the interest lay in catching a trout in this particular stream and not in the weight of the creel? This was a new concept to the writer, and since that day limits have no longer been the measure of successful fishing days.

There is a very special joy in finding out streams where there are native trout undisturbed by any artificialities. Wilderness streams would always provide this thrill in addition to serving as scientific laboratories. It is to be hoped that suitable reserves for fish will be set aside in the parks before it is too late.

Wherever trout are planted it is inevitable that birds and mammals will take a certain percentage of the total. Since man spends money and effort to place fish in streams and lakes, and intends them for his own use, he is dismayed when others share in the feast, enjoying meals that he has already bought and paid for. Yet it would be destructive of major national-park values to kill otters, ospreys, mergansers, kingfishers, mink, gulls, bears, loons, pelicans, and others, in order to prevent losses from those sources.

Inasmuch as fishing robs the fish-eating animals of their normal food supply, it would seem perfectly proper that a fair proportion of the output of the fish hatcheries should be allotted to them. Members of the fishing fraternity would be the first to grant this concession in return for the unusual privilege that is theirs in having their sport in areas otherwise closed to hunting. Nor can the problem of conflict between fish culture and the animals dependent on fish ever be solved satisfactorily until the principle is recognized

that man must raise trout for the wild life as well as for himself in national parks.

This does not mean that precautions against excessive depredations can not be taken. The most effective of these is to hold trout in rearing ponds until they are at least 6 inches in length, which, after all, is only practicing what fish culturists advocate as the proper restocking method anyway.

Occasionally bears raid fish traps. This is a special form of damage which has been met successfully by surrounding the inclosures with live wires. A consistent offender that refused to be put off

FIGURE 27.—Even the beloved water ouzel stole trout from this fishing water. Photograph taken September 5, 1931, at Red Eagle Lake, Glacier. Wild Life Survey No. 2200

could be destroyed or trapped and shipped away. The same treatment of taking the life of an individual bird or mammal inflicting abnormal havoc may be permissible at other times, but it should always be a special case with certain proof of guilt at hand. To wage war against a species would be to sacrifice the whole purpose of the park to one special interest.

Red-breasted mergansers in Glacier.—Glacier National Park abounds in good fishing. Mergansers were seen on a few occasions by the survey party during five weeks of travel in the park. The relative scarcity of these birds in what seemed to be such ideal ground for them was the subject of comment.

A family of five mergansers was reported to be active in the immediate vicinity of a recent planting of trout at Red Eagle Lake. A

trip to the lake revealed the presence of the following: Water ouzels, one of which was seen with a small fish grasped firmly in its mandible; kingfishers, which were common; one osprey; mink tracks; and the merganser family.

Admittedly, mergansers consume large numbers of fish. Nevertheless, the killing of five mergansers could not be condoned except as a last resort. It would be better to try every other possible means first. Planting larger trout would help. Distributing them all along the shore instead of at one or two points would minimize the concentration of the fish and hence lessen the loss. Then there is still the

FIGURE 28.—When unarmed people invite intimacy with a large powerful animal, such as the black bear, injuries are sure to result. Photograph taken November 3, 1929, in Yosemite Valley. Wild Life Survey No. 22

possibility of keeping the mergansers off for a few days until the planted fish have established themselves in their new surroundings. This is a problem worthy of careful study to devise a better solution than destroying a valuable park bird.

ANIMALS INJURIOUS TO LIFE OR PROPERTY (12)

In the national parks man enters into close contact with the fauna, a different relationship from the one that has prevailed for thousands of years. But only one party to the age-old conflict has agreed to a cessation of warfare. It is the altruism which always rides more easily on the brow of the victor. The animal life has not developed

any altruism. It must continue to fight for its existence, always motivated by the necessity of the moment.

It would be profitable in meeting the problems which have resulted from this new situation to analyze the human-animal relationship further. The larger animals are physically more powerful than man, better equipped with natural weapons of defense and offense. On the other hand, man's intellect has devised weapons so effective that some animals have become extinct, and many others would be, if man himself did not have a different purpose. In addition to the older purpose of using up and destroying the wild life about him,

FIGURE 29.—Barn broken into by grizzly searching for oats. If bears and man are to live in close proximity, buildings containing food will have to be made bear proof. Photograph taken September 14, 1929, at Lake Lodge, Yellowstone. Wild Life Survey No. 510

man has recently discovered a new purpose, which is to utilize the fauna in certain localities by saving it in its natural state for the recreational and scientific benefits. Wilderness preserves such as national parks perform this function.

Consequently, when visitors enter national parks their old weapons and purpose are laid aside. They come into a new contact with animal life in which they have no means of defense but in which the animals still retain their weapons. As a result, every year a few visitors are injured from this new contact which they do not quite understand. It really happens from a failure to realize what a wild

animal is, and to keep alert to the fact that the animal can not have a knowledge of the game as it should be played in a park.

As man's purpose is to leave the fauna undisturbed, the proper attack for problems of this sort is through education of the park visitor to an understanding of how to make the new sort of contact with the wild life. So long as people without weapons of defense invite too close an intimacy with animals that are well armed, injuries are sure to result.

Destruction of property and too close association with offensive animals, such as skunks, can be averted by the use of human ingenuity in inventing protective devices. The additional expense involved is justified in the same way that costly road building is justified, namely, the preservation and development of the values for which parks are created. Here, as elsewhere, in meeting wild-life problems the death penalty should be the last resort. It is only necessary in rare instances and should never be directed against the whole population of any species. The rattlesnake is the only candidate to be indicted so far, and even it should not be condemned without fair trial.

Rattlesnake in Yosemite.—Reptiles are a very ancient form of life, having dominated the earth long before mammals and birds ever appeared. They still play their part in the scheme of nature, and are just as much a part of the parks' fauna as any other vertebrate. Unfortunately, the rattlesnake menace assumes far more importance in the human mind than the facts would warrant. Conservatively speaking, it is not one ten-thousandth of the hazard that the automobile is, and it is not one five-hundredth of the hazard that the bear is. But, nevertheless, it is naturally feared because it is a lurking, unseen danger and because folklore has made it abhorrent.

To cut short all useless discussion, this much seems justifiable. In centers of human habitation, such as the floor of Yosemite Valley, the rattlesnake should be killed. Elsewhere throughout the park it is not worth worrying about. The reasoning is analogous to that which determines that railings shall be provided at the human concentration points on the cliffs of Yosemite. No one considers that it is necessary to fence the entire rim.

Bear damage.—In point of amount of injury to people and their property, the bear is chief offender. In fact, this is the only major problem of damage to man by animals in the parks. Numbers of park visitors have been scratched or bitten or cuffed by bears, and many more have suffered property losses. It is a serious administrative concern inasmuch as the Service is obligated to provide for the reasonable safety and comfort of the visiting public.

There would be no logic in destroying the bears and none in keeping the visitors away from them, for that is the very thing which they

came to see. Some other solution must be sought, and so far no program has been entirely successful. It is safe to say that this question never will be solved until a thorough understanding is had of all the causes. Corrective measures are certain to fail until the direct causes of the problems are dealt with. The fallacy of spreading an inviting feast for bears and then "taking them for a ride" to remote sections is evident. The bears travel in a vicious circle, but obviously it is man who keeps them running on that path.

Realizing, then, that the general cause of the problem lies in the nature of the relationship which man has developed in his new contact with this animal, the following suggestions are offered as a means to an analysis of that relationship.

(a) Attempt to discover exactly what the situation was whenever an injury was sustained. Perhaps it would become evident that all cases of personal injury from bears come from the human practice of feeding the bears by hand.

(b) Ascertain definitely whether it is a certain few bears which cause all the injuries. There is some indication that this is the case.

(c) Study the bears themselves—*i. e.*, their relative numbers, past and present, their food supply, their habits with young, etc. Perhaps there is an abnormal population of bears brought about by increased food supply; perhaps their natural food is subnormal; perhaps it is neither of these factors, but some other.

(d) Make similar investigations of all reports of property damage.

Upon the results of these investigations remedial measures might be devised. It is almost a certainty that no single factor is the cause, and, consequently, no single measure the remedy. But this much is offered in accord with the original statement of the problem: Since the whole situation is one of maladjustment in this new form of human and animal contact, the fundamental remedy would lie in reaching a suitable adjustment between man and animals in the parks. It is easier to make the human adjustment to a new circumstance than to coerce the animals. In other words, man will have to learn that in this new situation wild animals are still wild; and that, even though the animals are there for man's benefit and enjoyment, he will have to learn how to enjoy them. He can not feed them, pet them, domesticate them, and have them in an unnatural proximity without paying the consequences. When a man stops to feed a bear by hand and have his picture taken in the act, he simply does not know what that bear is until the bear strikes him in the face. It is significant that those who live in the parks the entire year are rarely the ones who are injured. They have learned the best adjustment to the new situation.

To educate people to this point of view, for their own safety and pleasure, may take several years, but there seems to be no other course. Concerning the bears themselves, such measures as dogging, trapping, treeing, shooting, and all the rest, are helpful during the stage of transition, but they will never be the ultimate solution. Certain bears which are found to be constant criminals should be disposed of. If the bear population becomes abnormally large, some reduction should be made to approximate the normal carrying capacity of the range. But such measures should be undertaken only after the facts are definitely known.

Since the wild animals of the parks do not go out of their way to do injury to people, there is no reason why man and animals should not mingle in these areas with perfect safety to each, provided each keeps in his own sphere.

Concerning the property damage of bears, procedure should be on the same natural basis. Bears are equipped by nature to tear up obstacles to get their food. They have powerful muscles, claws, teeth, and tough hides. They will always get their food wherever it is physically possible for them to reach it. Therefore, if man is going to live in close proximity to bears he must protect his property by devices which bears can not break. This is an expense. When we say that we can not afford a thing, we mean that we do not value it as highly as we do something else. But either the property damage done by bears is worth doing something about or else it is not worth considering. The list of personal injuries and property damage, however, is such that it demands consideration. This means that in the scheme of parks' administration the bear problem must be provided for in the budgets as well as items of road construction and police protection. If food is not available around human habitations, bears will not stay there long.

Certain animals do no physical injury to man but merely cause his discomfort. Minor readjustments will take care of these problems and it will not be necessary to impair the status of the offending animal.

If hotel guests complain, as they frequently do, that woodpeckers on the roof disturb their slumbers, it is better to enlist the sympathies of the visitor for the woodpecker or to move him to an inside room than to make an innocent bird pay the penalty. If skunks are a pest under habitations, it is more consistent with park policy to proof the basements against ingress than to kill the skunks.

HUMAN DEVELOPMENTS HARMFUL TO WILD LIFE

Where man's influence in the park is detrimental to the fauna, the resulting problems are the reverse of those discussed in the immedi-

ately preceding pages of this section. Yet the two conditions are frequently retroactive in that one may be the cause of the other, the complex bear problem being a notable instance.

It is obvious that numbers of people can not dwell in the park without displacing the fauna from human centers and otherwise disrupting the sensitive ecological relationships of nature. Yet, since use of the park by people transcends all other considerations, the most farsighted administrative policy is to make all needed developments but to do them in such a way as to minimize the disturbance of the biota as much as possible. If an alternate means of providing a needed development which will be less disturbing to wild life can be employed, it should be done even if a larger expenditure of money is thereby involved. On unavoidably disputed grounds, the keynote to management lies in the choice of a middle course allowing maximum use for both parties to the conflict. Developments for the benefit of the visitor must not be unduly hindered nor should the wild life which he came to enjoy be destroyed.

There is no doubt that many of the injurious effects of human occupation upon the native fauna have not been discovered as yet. However, certain problems have become manifest and hence can be discussed here.

DISTURBANCES IN DEVELOPMENT CENTERS (13)

Though the whole of a national park is nominally a primitive area, in reality the condition of its wild life varies from almost complete wildness in remote sections to high artificiality in the centers of human population. The violent disturbances of the normal biotic relationships around these development areas engender many acute faunal problems. As these are man-made situations, human intervention to correct them is not a transgression of policy. But just as in every other wild-life problem in a park, no action is permissible until a proper investigation has revealed that the condition is absolutely referable to an artificial cause and that the proposed remedy is not in itself likely to have injurious effects.

As has been suggested, the injury to landscaping around buildings may be due not so much to the utilization of forage by normal animal numbers as to the depredations of abnormally congested animal populations. This abnormal congestion may be caused by the absence of the control species. The control species, in turn, may have been displaced by the development of the area. Thus, the whole vicious circle completes itself. In each park the complex faunal maladjustments which exist in the vicinity of hotels, camps, and utility areas should be carefully studied and definite stabilizing programs formulated upon the findings. It is not sufficient to say that natural conditions are impossible in these sections and to let it.

go at that. Though they can never be truly natural, they can be improved and made to be more nearly natural. It is the more important in that these are the very places where it is desirable, from

FIGURE 30.—If all dead trees are removed from the vicinities of roads and development centers, the birds that depend upon them for nesting, feeding, and perching will not be seen by the majority of visitors. Photograph of nesting tree of flickers and bluebirds taken July 19, 1930, at Poudre Lake, Rocky Mountain. Wild Life Survey No. 969

the visitor's standpoint, that the true story of wild life should be told. More people see animal life around the camps than anywhere else, and the majority of ranger-naturalist trips are made in their immediate vicinities.

The floor of Yosemite Valley.—No other spot in a national park has as many wild-life problems of this type. Permanent residents alone number several hundred, and there are days when ten to twenty thousand people and thousands of cars are circulating in an area approximately 6 miles long by 1 mile wide between the great confining walls. They constrict the seasonal drift of game into a bottle neck. These walls tend to isolate the characteristic transition-zone fauna of the valley from any near-by source of replenishment. Further, the cliffs restrict the movements of visitors, with the result that by far the greater percentage of them never leave the valley itself. Wild life of the floor is the only wild life that they see in the park. Hence, it is of the utmost importance that this part of the park fauna be preserved intact.

Yet it is only because the natural conditions are so abundantly favorable that the wild life has resisted decimation as well as it has. Probably every plant and animal has been affected by human invasion. Some of the more conspicuous adverse influences are discussed here. No criticism of the splendid administration of the area is implied, the purpose being merely to demonstrate some of the adverse effects of human populations upon the faunal resources.

(a) Oil is spread on dead waters seasonally as a mosquito-abatement measure. This spells death to birds of many species that come to the quiet pools to bathe. One of the writers has picked up dozens of oil-soaked birds in the meadows, and within the space of a half hour once saw two blackbirds and a robin floating down the Merced River. Total losses from this source must be considerable.

(b) Clean-up work. Many standing snags have to be removed in the interest of human safety because they are located near roads and buildings. This has unfortunate consequences in the elimination of necessary nesting, concealment, and food habitats for many species of both birds and mammals, including flying squirrel, screech owl, spotted owl, saw-whet owl, pigmy owl, hairy woodpecker, willow woodpecker, white-headed woodpecker, pileated woodpecker, California woodpecker, red-shafted flicker, violet-green swallow, red-breasted nuthatch, and mountain chickadee. Fortunately, the policy of allowing dead trees to stand wherever possible has been in force in the valley for some time.

Dead brush and downed timber must be largely removed where there are so many people, and the visitors utilize all dead wood available around their camps for kindling. This means a habitat loss for a long list of mammals and birds.

(c) Trampling. Barriers are skillfully used to keep automobiles to the roads and parking areas. Paths are provided both for

pedestrians and for horses. Nevertheless, the destruction of ground plants by millions of trampling steps is tremendously effective in destroying the food and protective cover of such vertebrates as deer,

FIGURE 31.—The pigmy owl, bird demon of Yosemite Valley, nests in vacated woodpecker holes. Its continued presence depends on the availability of its particular housing needs. Photograph taken July 2, 1929, in Yosemite Valley. Wild Life Survey No. 7

chipmunks, and ground and bush-nesting birds. Yosemite has set the example in adoption of measures to minimize the sheer physical destruction to wild life resulting from concentrated human populations

(d) People accidentally reveal concealment places of nests and of young to lurking enemies. In Yosemite countless bird nests are discovered by humans who do not harm the eggs or young themselves but all unwittingly betray them to marauding blue-fronted jays and squirrels. This tends to increase the losses from these sources abnormally. Moreover, the jays are, if anything, more abundant than normal because man has brought them an increased food supply. In this particular instance the effect of development is to help the enemy and injure its prey.

FIGURE 32.—People discover the fawns of mule deer secreted in the meadows and so unconsciously help to reveal their hiding places to lurking enemies. Photograph taken July 14, 1929, in Yosemite Valley. Wild Life Survey No. 2427

Fawns of mule deer are secreted in the tall clumps of saw grass and in other nooks about the valley during the first days of their lives. Their spotted coats make them inconspicuous, and the members of this family have an added protection in being scentless when they are very small. When visitors go to the hiding places or handle the young fawns, they leave a blazed trail for the predators to follow. Black bears and coyotes frequently kill fawns in the meadows and this may be one reason why they discover them more easily.

(e) Relation of travel season to food supply. During the summer season, the food supply of some animals is greatly augmented and their numbers about development centers are increased thereby. In Yosemite Valley this is certainly the case with black bears and, very probably, with mule deer. When fall comes this artificial food is no longer available and the drain on the natural food becomes very heavy, with detrimental results to both forage and animals.

(f) Displacement of predators in its effect upon rodents and ungulates. Where man's presence influences one species adversely, the fact that it also keeps enemies of that species away is a compensating factor. But for species that thrive near civilization, the absence of the controlling predators increases the problem.

Mountain lions shun the valley. Even if their numbers were normal for the park as a whole, they would not linger where there are so many people. Both wild cats and coyotes frequent the valley, but do not hunt too near the camps and buildings. The same is generally true of the larger hawks. Consequently man has not

FIGURE 33.—The browse line on this chokecherry clump indicates how the mule deer are forced to utilize every bit of available forage during certain seasons of the year. Photograph taken July 20, 1929, in Yosemite Valley. Wild Life Survey No. 195

only favored the California ground squirrels with an excellent food supply, but he has protected them against their natural enemies until they have multiplied greatly. This is one instance where safe control measures applied to those particular areas would be actually beneficial to wild-life values. Shooting the squirrels around buildings or camps is perfectly safe and sufficiently effective as a control measure.

DISTURBANCES ON BREEDING GROUNDS (14)

Colony-nesting birds in general are intolerant of invasion of their breeding grounds. A constant trek of visitors may lead to abandonment of the colony. Inasmuch as some species do not easily find sites which are suitable for their particular nesting requirements,

they are likely to leave the park as well as the area from which they have been driven. The loss of any species in the faunal quota of the national parks is a tragedy.

FIGURES 34a, 34b.—Such large ground-nesting birds as the sandhill crane can not persist where there is much use of their breeding grounds by people. Photographs taken June 8, 1931, in Bechler River district, Yellowstone, by G. M. Wright. Wild Life Survey Nos. 2310 and 2311

But even if the birds continue to frequent the colony, their numbers may be reduced from year to year through the destruction of eggs and young which accompanies the precipitate flight of the adults

and prolonged absence from the nests. So the ultimate fate of the colony may be the same.

This situation can be readily met by making special administrative areas of the nesting grounds so that all entry may be barred during the critical season. The best interest of the birds can be safeguarded in this manner without appreciably restricting the use of the park as a whole. Moreover, under favorable circumstances, arrangements may be made for the observation of the activities going on in the colony from some vantage point near by.

Even solitary nesting species would be benefited by this type of protection in some instances. Any large ground-nesting bird that is rare should be investigated from this standpoint. If the Bechler River district of Yellowstone were ever developed (a move which the swarms of mosquitoes should effectively block), one of the last strongholds of the sandhill crane would be endangered. This bird can not nest successfully where there are many people. The following incident is illustrative. A member of the field party flushed a brooding sandhill crane. In its hurried departure the bird knocked an egg out of the nest. With a bird that lays two eggs to a clutch, such a loss is a serious matter and the crane is so rare that every individual is precious.

The problem of special protection on breeding grounds is a minor one in most parks, though, in the case of the proposed Everglades, the major objective of development would be to establish a mutually advantageous relationship between the visiting public and the great bird rookeries.

White pelican in Yellowstone.—Grotesque on land and superb in flight, the strange white pelican is one of the most interesting members of our avian fauna. It is estimated that the agency of man has reduced its numbers in the United States by half in the last quarter century. The only white pelican breeding colony now found within the confines of a national park is at Molly Island, in Yellowstone Lake. This is a small colony of between one and two hundred breeding pairs.

Human trespass on pelican islands during the breeding time is injurious to the birds in several ways, as E. Raymond Hall¹⁸ has shown in his studies of the great colony at Pyramid Lake, Nev. Eggs are broken and the downy young are wounded or killed by strokes of feet and wings when the old birds are suddenly frightened into flight. A little later on the young pelicans mass together in pods. These pods stampede at the approach of an enemy, with the result that many individuals are trampled and left behind dead

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¹⁸ Pelicans versus Fishes in Pyramid Lake, by Hall, E. Raymond, the *Condor*, Vol. XXVII, pp. 147-160, July, 1925.

or dying. If the parents are driven off during the middle of the day, the pelican babies and eggs are killed by the heat of the sun; if at night, they will perish from cold, depending, of course, upon the length of exposure. Moreover, the white pelican is one of the birds that readily abandons a nesting island if it is disturbed. There are instances where this has happened and the birds have never returned.

The protection of the Molly Island colony is simplified because the island is sequestered in a southern arm of the lake. However,

FIGURE 35.—This pod of white pelicans, representing the entire 1931 crop of the Molly Island colony, fled at our approach. When a pod is disturbed in this way while the birds are younger, some of its number may be trampled to death. Photograph taken July 18, 1931, at Molly Island, Yellowstone, by G. M. Wright. Wild Life Survey No. 2317

future developments could change all this, and even now precautions are necessary to prevent too many visits to the island.

Sanctuary status for species which have their rookeries on main-land requires more administrative effort, such as is involved in posting signs, erecting barriers across roads, and running special patrols.

PASTURING OF SADDLE HORSES (15)

One of the accompaniments of man in the park has been the occupation of the range by horses, which are kept both as an administrative necessity and for recreational use. Nevertheless, there is a certain inconsistency in use of the park range by this stock.

Man does not maintain himself in the park at the expense of that park's resources. With this single exception, everything that is needed for human use is brought in from the outside. There is no more reason why the native range of the game should be used to support the horses which man rides than that it should be utilized to feed cattle to provide meat and drink, or plowed up to raise vegetables. The practice of importing finished foods so that nothing will be taken from the park is so much a matter of custom that the costliness is borne without question. Should not the same principle apply to the sustaining of livestock?

Horses impose a heavy drain upon the resources of the range. Scarcity of winter range is one of the most important wild life problems in nearly all of the parks. The forage utilized by the stock must be paid for later on by artificial winter feeding of game.

EFFECTS FROM THE MANNER OF WILD-LIFE PRESENTATION (16)

The art of appreciation of wilderness life in national parks is still in the beginning stages of development. It is the first sort of contact that most people have ever had with large animals roaming at liberty. In the novelty of the experience it is natural to exercise the same standards of enjoyment which apply to the appreciation of the so-called wild animals of zoological gardens. There the most exciting factor was the proximity to the wild caged animal. In the parks the visitor realized the highest joy in the new contact when his picture was taken stroking the back of a deer. If the object of affection could be that more formidable animal, the bear—well, so much the bigger impression on the home folks.

The new emphasis is on perfecting the manner of presentation of the visitors to the wild life rather than on how the animals can be drawn out of their natural wilderness existences to be presented to the visitors. Through the educational branch of the Service, thousands of people are being led for the first time to an appreciation of the greater fascination of wild life in nature as compared to the paler pleasure of feeding semidomesticated animals by hand. They are beginning to seek the story of the endless change and struggle and the marvelous interrelations of all living things in the wilderness.

This new idea is a more sophisticated concept than the old one and hence it does not represent the state of mind of the majority as yet. But all of the progress made in the park system, including its very conception, has been based on an idealism which did not wait for the average standards. If national-park developments had been based on the absolute level of average ideas, they would not be anything more than amusement parks to-day.

FIGURES 36a, 36b.—The ruffed grouse crossing the road presents but half the picture. The hoary marmot family on its home ledge is complete in its natural setting. Photograph of ruffed grouse taken June 25, 1930, at Blacktailed Deer Creek, Yellowstone. Wild Life Survey No. 701. Photograph of hoary marmot taken September 1, 1931, at Cracker Lake, Glacier, by G. M. Wright. Wild Life Survey No. 2181

All of this may seem far removed from the question of animal problems, yet there is a close connection. If the animal life is to be coerced into an abnormal life for presentation to the visitor, the situation is fraught with possibilities of disastrous effects both upon the species concerned and the biota of the park as a unit. If the wild life is left in place and man introduced to the whole natural picture instead of being shown tamed animals, there will be much less disturbance of the natural balance and hence fewer problems.

FIGURE 37.—Dall sheep are at home on the shaly cliffs. The joy of seeing the animals in their natural setting can not be equalled by any other manner of presentation. Photograph taken July 22, 1926, at Double Mountain, Mount McKinley. Courtesy of the Museum of Vertebrate Zoology, University of California, Berkeley, Calif. Mus. Vert. Zool. No. 5200

Bears in Yellowstone.—In an earlier discussion the dangers to man in the conflict between visitors and bears were analyzed. There is another side to the question in the harm which may come to the bears from the new contact. This can only be postulated, for there has not been time enough as yet for changes to become manifest and no research has been undertaken to make definite determinations.

The manner of presentation of bears in this and other parks has been to feed large quantities of garbage in arenas, there being one or more of these according to the distribution of human-population centers. This has brought about unprecedented concentration of bears in small areas in Yellowstone. What are some of the adverse or possible adverse effects upon the bears resulting from this manner of presentation?

(a) The intimate association of many bears at one time on the feeding grounds must facilitate the spread of diseases or parasites which may be endemic in bears in Yellowstone, or of any diseases which may be introduced among them.

(b) The garbage itself, including the remains of domesticated animals, may introduce parasites.

(c) The rich concentrates in the garbage are an unnatural food for bears; and if feeding of them is continued for many bear generations,

FIGURE 38.—There is no lordlier sight among the animals of the United States than the grizzly bear when it is found in completely natural surroundings. Photograph taken September 13, 1929, at Canyon Lodge, Yellowstone. Wild Life Survey No. 507

injurious physiological changes in the make-up of the bears are exceedingly likely to occur.

(d) The garbage season is coincident with the tourist season and not with the bear requirements. As a result of this uneven distribution of food, there is likely to be a scarcity of feed at the critical times. If it is true that because of this unnatural condition the females go into hibernation in a poor condition, there is a genuine possibility that the cubs born in the winter months will suffer until eventually degeneration of the race will take place as a result.

(e) Inasmuch as the garbage is concentrated in areas a few yards square, the old bears are able to dominate the situation at the expense

of the younger animals. It is possible, on the other hand, that the young animals learn only the feeding habits of their elders; and not being trained to rustle their natural foods, become the small scrawny hold-up bears so common on the Yellowstone roads.

(f) The garbage pits must cause a desertion of the niche formerly occupied by the bears in the summer time, thus further disturbing normal biotic relationships in the park.

(g) Garbage feeding attracts the bears to the vicinities of the food stores of campers and encourages a lack of fear of man. The cubs know no such fear right from the start. In the new contact the bears offend man, who has the whip hand, so that the bears are bound to be the sufferers in the end.

(h) Bears appear at their worst on the garbage platform, so that their characters, in the minds of the visitors, suffer as well as does very probably their physical well-being from this manner of presentation.

To conclude, it might be said that this manner of presentation of bears is very likely to be to the ultimate detriment of the bears. Certainly it is responsible for much of the injury to man. The bear show has been one of the greatest assets of the national parks. However, it has served its greatest purpose in the period when bringing the people to an appreciation of the wonderful things to be seen and done in the parks was of prime importance. Now that the popularity of their values is established and their place secure, it may be necessary to modify the old practices in the interests of the welfare of both people and bears.

The whole question is one which deserves thorough study, for there is no doubt but that the bear problem is increasing in magnitude in Yellowstone and other parks. It may be feasible to reduce the amount of feeding and to improve the selection of food. Perhaps a natural bear food, such as honey, could be used to attract bears to certain places so that the visitor limited to a very short stay in the park could be assured of at least one good view of a bear. The sight of one bear under natural conditions is more stimulating than close association with dozens of bears. Even now one hears more accounts of encounters with an individual bear than of the bear show.

CONSPECTUS OF WILD-LIFE PROBLEMS OF EACH PARK

As desirable as it would have been to make the preliminary study inclusive, circumstances did not permit visits to every one of the national parks. Therefore there are a few which do not appear in this section. Most emphatically this does not mean that they are not significant as regards wild life nor that they have no faunal problems. Some of the parks which were said to have no important vertebrate animals were found, on the contrary, to have unusual interest from this standpoint. Nearly every park can add some forms to the quota which will some day give the national parks a full representation of all the fauna of our country. The assumption should be that every park and monument shall be carefully studied for the animal life that it either has or, by restoration, should have.

Lest the wrong significance be accredited to the treatment of faunal problems by parks in this section, the reassertion is made that the survey did in no case make a complete study of the thoroughgoing sort outlined in the chapter on Methods Adapted to Faunal Investigations. Where only weeks were available in any one place for the preliminary survey, it will take months and years to make the exhaustive studies. However, it was possible to get a general picture of the status of wild life in each of the parks visited. Some of the basic conditions causing faunal maladjustments in each park were noted and some suggestions on how to attack the problems were formulated. These observations are recorded here not to take the place of further work but to stimulate it and perhaps to serve as a prospectus.

It is because there is a useful significance to the arrangement, from a biotic standpoint, that the parks have been grouped here by regions. The Southwest parks are alike to the extent that analysis of faunal relationships in one of them will be helpful to a study of others in the group. Eastern parks show a greater disparity, yet even here there are similarities of topography and climate which give them a unit character and the grouping has administrative value.

SOUTHWEST PARKS

Bryce Canyon, Carlsbad Caverns, Grand Canyon, Mesa Verde, and Zion are the national parks of the desert. They are characterized by plants and animals which are highly specialized to cope with the rigors of arid climate. Their special adaptations and their tri-

umph in a portion of the world that, to us at least, seems hostile to life are constant sources of interest to the traveler.

On the other side, the relations between fauna and environment are so critical that even slight disturbances may be disastrous. For instance, the mammals and birds of many square miles are sometimes dependent on a single water hole. If this is destroyed or preempted for human use, the wild life of that particular area will suffer accordingly. Bunch grasses are easily destroyed by grazing, and the forces of erosion readily loosed so that floods carry away the necessary and all-too-scarce green bottoms and leave the precious springs to go dry the rest of the year.

FIGURE 39.—The Bailey collared lizard is one of the specialized forms of animal life which are found in the desert. Photograph taken May 31, 1931, in Zion Canyon, Zion. Wild Life Survey No. 1842

It behooves man, because of these things, to tread lightly in developing these parks. The greatest circumspection must be used in order that the wonderful desert life which is one of their distinctive attractions shall not be destroyed.

BRYCE CANYON

At Bryce Canyon the situation is such that protection of animal life is a virtual impossibility at present. The park is about 3 miles wide by 20 miles long. Sheep and cattle are grazed all around it. And on these grazing lands the predators are trapped, hunted, and poisoned. Even though the park embodies only a narrow strip of cliffs, it is charged by the stockmen in the vicinity that it is the

breeding ground of mountain lion, coyote, wild cat, and other predators, and the extermination of these animals in the park is demanded. The lands recently added to the park still carried the signs posted by field men of the Biological Survey, and on the trail leading up to Bryce Natural Bridge could be seen the remains of a mountain lion trapped on the rim in 1930. Under such circumstances it is impossible to have primitive conditions in the park. The question is not the justice or injustice of the stockmen's point of view; it is merely a presentation of the fact that animal life can not be effectively protected at Bryce under the present circumstances.

Overgrazing has long been apparent in the region all around Bryce. Readjustments will come inevitably in the sheep industry in this section because the poverty of the range will check the industry. If the range within the park can be preserved from further destruction, much can still be accomplished toward restoration of animal life in the park. Sheep and cattle must be excluded from the park as soon as possible. Cattle drift into the park along the west-entrance road and along the entire west boundary. Immediately west of the park a long, narrow, grassy valley, through which a branch of the Sevier River flows, parallels the park line. Cattle and horses are grazed in this valley. The park boundary is an artificial line following the section lines zigzag fashion up through the timber just above this valley. Obviously there is nothing to prevent domestic stock from entering the park. An attempt was made to establish a game preserve down to the stream in the center of the valley, but was defeated by local opposition. There seems to be only one other course; that is, to acquire this valley for the park, and move the boundary to the crest just west of this little Sevier Valley. Such a course is the only way to protect both the fauna and the flora of the park.

CARLSBAD CAVERNS

A cursory examination of the interesting animal and insect life of the caverns gave us the impression that on the whole it remains unhampered by the introduction of the human factor. The bats, ring-tailed cats, spotted skunks, cave mice, crickets, spiders, and flies were all about their dark and devious businesses.

The surface area of the park is insignificant, offering small asylum for the wild life of the region. After hours of isolation from the living world, the green plants and moving creatures of sunlight were hungrily sought for. We were entertained by the nesting activities of a pair of cactus wrens close by. A rock wren dined on delicatessen fare, cold-storage insects from the radiator of an old Cadillac bus. A horned toad sat blinking in the center of a white-pebbled ant hill. Curve-billed thrashers, black-throated sparrows,

and rock squirrels were seen within a radius of 500 feet of the cave entrance.

The cavern, however, is located at the very edge of a wonderful game country. The valleys and canyons of this region tap the great faunal reservoir of the Lower Sonoran Zone, which spreads away to the south and down into Mexico. Immediately adjacent rise the Guadalupe Mountains, a high desert range intersected by deep, hidden canyons and wild gorges where there is haven for many of the rare animals now gone from the more settled localities. This was the natural habitat of peccaries, mountain sheep, deer, mountain

FIGURE 40.—A pair of cactus wrens were building this nest near the mouth of Carlsbad Caverns. After the visitor has spent hours in the still dark cave, the bustling activity and lively calls of these wrens and other surface dwellers provide a welcome contrast. Photograph taken April 25, 1931, at Carlsbad Caverns, by G. M. Wright. Wild Life Survey No. 2411

lions, wild cats, wolves, coyotes, grizzlies, black bears, and the colorful birds of the desert, such as the pyrrhuloxias and phainopeplas, and even the rare zone-tailed hawk and Aplomado falcon of the arid tropics. The plants range in type from the sotol, lechuguilla, and narrow-leaved yucca of the desert up through the junipers and straggling hardwoods to the yellow pine forest on top of the mountain.

The Carlsbad region takes on added significance in the enlarged concept of the national parks to include the preservation of representative and outstanding examples of the biotas of the country. Fauna and flora of this section belong principally to old Mexico. Yet in the northern forms which have found a haven on the cooler

walls of the north slopes there is seen a striking mingling of austral and boreal types.

In consideration of flora and fauna, it would be a fine thing to supplement the underground feature of Carlsbad with the addition of the eastern watershed of the Guadalupe Mountains southeastward to their culmination in Guadalupe Peak in Texas. The present park is located in the northeastern foothills of this range.

FIGURES 41a, 41b.—Immediately adjacent rise the Guadalupe Mountains, a high desert range intersected with deep, hidden canyons and wild gorges where there is haven for many of the rare animals now gone from the more settled localities. Photographs taken April 25, 1931, in Guadalupe Mountains, New Mexico, by G. M. Wright. Wild Life Survey Nos. 2415 and 2416

Four outstanding species native to the Guadalupes have not at the present time a place in the national parks. They are:

MERRIAM TURKEY (*Meleagris gallopavo merriami*).—This great bird is present in the Guadalupes to-day through reintroduction a few years ago and is reported to be doing well. Mr. J. Stokley Ligon, who assisted in this task, hunted turkeys in these mountains 20 years ago when they were still common.

TEXAS BIGHORN (*Ovis canadensis texiana*).—The Guadalupe Mountains are the type locality of this rare form. In spite of protection, under the present set-up the Texas sheep is barely holding its own. Estimates indicate that there may be 100 in these mountains. The only other places in the United States where Texas bighorns are found are the Big Hatchet Range, supporting a few, and the San Andres Mountains, which still harbor a bare remnant.

"It is highly desirable that the main portion of the Guadalupe Mountains, from the Carlsbad Cavern, south to the point of the mountains in Texas, be made a permanent mountain sheep sanctuary and nature wonderland. In order to do this, the area should be set aside as a national park or a wilderness area and left in its natural state, except for saddle-horse and pack-animal trails. This is one of the most interesting, rugged, and picturesque mountain ranges of the country, and is of little use to the State for grazing or other economic purposes; but as a mountain sheep sanctuary and a public reservation, it is of prime importance. There is ample overflow range both in New Mexico and Texas for surplus game and by establishing such a reservation, the citizens of both of these States would be creating a lasting monument of beauty and interest."¹⁹

COLLARED PECCARY (*Pecari angulatus*).—These so-called wild pigs used to roam in the foothill country of the Guadalupe Mountains near Carlsbad Caverns. Years ago they were wiped out of this area by the encroachment of civilization. But they still exist in the desert east of the Pecos River, whence a small supply for reintroduction into the Guadalupe might be procured. This would introduce a very rare and interesting animal to many who would otherwise never see it. It would provide a sanctuary for an animal which is rapidly disappearing. And it would restore to its native habitat an animal which is a unique product of the desert foothills and ravines, to increase the interest and pleasure in this wild and fascinating country.

MEARNS QUAIL (*Cyrtonyx montezumae mearnsi*).—This bizarre little quail is to be found in the lower places along the Guadalupe where it digs its favorite food, the bulbs of the nut grass. Its numbers are becoming rapidly decimated through the destruction of cover by grazing. In an enlarged Carlsbad Park the Mearns quail would find real protection.

Besides the species noted above which would be of exceptional interest, there are many other forms of wild life, such as kangaroo rats, prairie-dogs, band-tailed pigeons, and scaled quail. The Merriam elk of the Southwest has vanished forever, but the American wapiti has been planted in the southern end of the Guadalupe and is reported to be spreading northward already. The grizzly was exterminated long ago, but the black bear remains.

There is real scenic grandeur in the Guadalupe Mountains and canyons, although the range looks like a barren mesa when viewed from the highway far off in the desert. The Guadalupe are the

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¹⁹ Wild Life of New Mexico, by Ligon, J. Stokley. State game commission, department of game and fish, Santa Fe, N. Mex., 1927, p. 92.

nearest mountains to a large population south and east of this section of the country, and therefore have a high potential recreational value.

GRAND CANYON

Grand Canyon National Park is laid out like most of the Southwest national monuments; that is, a boundary line drawn about the object of interest, the canyon, without regard for faunal requirements. While it is true that the canyon itself is the main attraction of the park, it is also true that nowhere else in the Southwest is there such a varied and interesting intergradation and division of faunal types. Each year the interest in the faunal story of the canyon region is growing. Back of the present status of wild life at the canyon stretches the paleontological story into the distant past. It is this great panorama of the development and adaptation of life as depicted in the canyon which gives it its meaning. We can not think of the canyon as one thing and its meaning as another. They are inseparably and integrally one experience. There is no break between the life of to-day and the primitive life which first left its imprint in the rocks of the canyon. The wild life of to-day is the most vivid part of that story; without it the rest would be colorless and lacking in both significance and reality. It is absolutely essential to the significance of the canyon that its native life be preserved. This means that the park must be made adequate for wild-life requirements.

The greatest danger to the park fauna is along the south boundary. In many places the boundary comes to the very rim of the canyon, so that grazing and lumbering are immediately adjacent to the canyon itself. This rim country is essential as summer range for park animals. To some extent the Grand Canyon situation is the exact reverse of that which obtains in the mountain-top parks of the Northwest: In winter certain animals withdraw into the park; in summer they move out of the park. The territory immediately south of the park has been so severely overgrazed in the past that for miles at a stretch there is almost no forest reproduction, and deer forage has been practically destroyed. This is an arid region which recovers so slowly that it will take many years, even under absolute protection, to recover and again be a suitable faunal habitat. This region should be added to the park to protect its wild life.

The ideal Grand Canyon unit would include the Coconino Plateau and a portion of the grasslands southwest of the present park. That would provide suitable antelope range and include a faunal unit cut off from adverse influences by the desert lying between the Coconino Plateau and the San Francisco Mountains. At present this is impossible of accomplishment, and, therefore, the minimum faunal

requirements must be met instead. This would require moving the south boundary back to a line at least 10 miles from the canyon rim at every point. All grazing should then be prohibited in this area to allow it to recover, and deer should not be encouraged.

It would seem inadvisable to extend the north boundary at this time because of the complications on the Kaibab Plateau. Due to the present policy of total protection for all predators in the Kaibab forest and the attempt to restore the range, there is no adverse influence threatening from that side.

FIGURE 42.—Mule deer wintering on this point have browsed the cliff rose (*Cowania mexicana*) until it presents an excellent example of an abused range, a fringe of the Kaibab Plateau deer problem. Note browse line on cliff rose at far right. Photograph taken June 1, 1930, at Point Sublime on the north rim of the Grand Canyon. Wild Life Survey No. 1128

Predatory-animal control has been recently discontinued. There is, therefore, nothing to be said about coyotes, wild cats, and mountain lions until sufficient time has elapsed to form judgment concerning these animals and their effects.

Within the last few years over 1,200 feral burros have been removed from the canyon. Until the vegetation recovers somewhat from the depleted condition which they caused, not much can be said about the animal life of the canyon. Perhaps the mountain sheep will increase as their range improves. They are still scarce.

ROCKY MOUNTAIN MULE DEER (*Odocoileus hemionus*).—The deer on the north rim of the canyon have been affected by the same causes which resulted in the superabundance of Kaibab deer. While forage conditions within the park are much better than they are on the

Kaibab Plateau as a whole, it is evident that there are still too many deer for the range. This statement is made exclusive of the few denuded points along the north rim, which probably are local winter retreats and might be overgrazed any winter if a few deer were forced to remain on such points. But considering a large area such as Powell Plateau, where the "high-water" line shows overgrazing as severely as at any point on the Kaibab, it becomes evident that the range needs special protection until it recovers. Probably the open season each year on the Kaibab Plateau will drain enough deer from the canyon region to relieve this situation.

Deer on the south rim have always been scarce because of lack of forage and water. The south-rim country is essentially a desert country in which the larger forms of wild life are never abundant as they are in more favored regions. It would never be natural to see large herds of game along the south rim. To transplant large numbers of deer or other animals from the Kaibab to the south side of the canyon would be to invite disaster. Even if sufficient water holes were artificially formed, the sparse vegetation would never support many deer, and the south-rim range is already subnormal. Beyond that, it would be destroying all of the significance of the canyon as a natural barrier between related forms of animal life. The significance of wild life on the south rim is that it is in a rigorous niche of nature where only the forms of animal life which could adapt to a desert region are to be found. It is normal in such a region to find few deer, many rodents, coyotes, wildcats, and mountain lions. There would be no point to any move which tended to change this harsh desert life to the sylvan type of forested Kaibab. Every effort should be made to keep these two regions as separate and distinct as they were when white man first found them. Even the bridges at the bottom of the canyon should be guarded in some way to prevent the faunas of the two regions from mingling.

AMERICAN PRONGHORN (*Antilocapra americana americana*).—The introduction of antelope into the canyon, at Indian Gardens, is still in the experimental stage. Its outcome will be awaited with interest. Whether the antelope will be able to adapt to the confined quarters of the narrow plateau down in the canyon is a question. The antelope is a plains form of animal, dependent upon flight to escape its enemies. This would not be possible in the canyon; hence it would be at the mercy of predators. It would be undesirable if the antelope should successfully increase and spread in the canyon, because where forage is scarce the competition becomes keen even between animals of diverse food habits, such as sheep and antelope. Mountain sheep belong in the canyon and are adapted to it. It would, therefore, be preferable if no alien member were introduced

into the canyon, thereby giving the native animal life full benefit of all available range. So long as the antelope of Indian Gardens remain in their present status, they are no menace to other forms of canyon life, but neither do they measure up to the Park Service aim of presenting animal life in its natural habitat.

MERRIAM TURKEY (*Meleagris gallopavo merriami*).—Wild turkeys were at one time abundant in the San Francisco Mountains region, and are still present in reduced numbers. Whether they ever crossed the intervening desert to the Grand Canyon region is not recorded, to our knowledge. According to Mr. Edward Hamilton, who has lived near the Grand Canyon for more than 40 years, turkeys were never found along the south rim. There is an abundance of food and yellow pine, but a lack of running water. If it could be found that they ever existed along the south rim, their reintroduction would add greatly to the interest of the Grand Canyon forest.

MESA VERDE

The logical faunal unit for Mesa Verde National Park would include the whole of the mesa north and west of the Mancos River Canyon. In order to avoid the usual complications of an unprotected winter range, the south and east boundary should not stop with the Mancos River in the bottom of the canyon, but should follow the east and south cliffs of the canyon. Then the entire Mancos Canyon, as winter range, would be within the park. The north and west boundaries of the faunal unit, so outlined, would follow the base of the cliffs where the mesa terminates abruptly on the north and west.

Within this area it would be possible to preserve all the existing forms of animal life which were of such great importance to the Cliff Dwellers a thousand years ago. This would give reality and color to the desert country as nothing else could.

The present park includes only a portion of the mesa north and west of the Mancos River. Animal life in the region is not now abundant, and it probably pays some toll to the Ute Indians. On the south and west sides of the park there are no present natural boundaries. It is like a house with two sides left open.

Considerable historical research will be necessary before the original (*i. e.*, before white men came) status of animal life on the mesa can be determined. The fauna of the mesa is complex in that it is predominantly Great Basin, but is in close proximity to Rocky Mountain forms.

GRAY WOLF (*Canis nubilus*).—The gray wolves are probably gone permanently. They were in the mesa region formerly. "According to Mr. Steve Elkins, of Mancos, none have been reported in that

region since the winter of 1904-5, when four or five were seen between Cortez and Mancos." ²⁰

BLACK BEAR (*Euarctos americanus*).—Black bears may have been on the mesa in the past, although we know of none now. Merritt Cary reported that "an old female and cub were killed on Middle Mancos River, 10 miles east of Mancos." ²¹

PORCUPINE (*Erethizon epixanthum*).—See pages 61-63.

BROAD-TAILED BEAVER (*Castor canadensis frondator*).—Nordenskiöld ²² reported beavers in the Mancos Canyon in 1891. Although they would never be abundant in these desert streams, they could still be maintained if sufficiently protected. If Mancos Canyon were included in the park, and the grazing of domestic sheep discontinued, there would be not only more beaver habitats but more forage for all forms of animal life which drift down the canyon in winter.

ROCKY MOUNTAIN MULE DEER (*Odocoileus hemionus*).—Deer are present, but not abundant, upon the mesa. They are wary and, consequently, not so commonly seen, although their tracks indicate their presence. Water is scarce, but there seems to be evidence that deer can and do go for weeks without it. Forage is abundant. It is thought that deer are taken by the Ute Indians whenever they can get them. However, aside from the question of providing suitable winter range for the deer, no other protective steps are necessary at present.

In 1927 four mule deer were shipped from Yosemite Valley to Mesa Verde. One of them died soon after shipment. Superintendent Finnan reports that the other three have had no fawns. The Yosemite deer are different from the Mesa Verde deer. It is to be hoped that no mixing of the forms will occur from this transplant.

ROCKY MOUNTAIN BIGHORN (*Ovis canadensis canadensis*).—Mountain sheep may have been on the mesa at some time in the past. The question of reintroduction of sheep is quite analogous to the wild-turkey question discussed in relation to Mesa Verde on pages 26-27. If mountain sheep could exist on the mesa, they would be a most attractive feature of the park. This question, however, is raised for what it is worth. Since it is the tendency of mountain sheep to bed down in the shade of cliffs and to climb all over the cliffs, how much would this accelerate the destruction of unrestored cliff ruins?

GAME BIRDS.—Wild turkeys have been discussed on pages 26-27. Dusky grouse (*Dendragapus obscurus obscurus*) are present and

²⁰ A Biological Survey of Colorado, by Cary, Merritt. North American Fauna No. 23, 1911, p. 196.

²¹ Ibid.

²² The Cliff Dwellers of the Mesa Verde, by Nordenskiöld, G., 1893, p. 5.

seem to be holding their own. Scaled quail (*Callipepla squamata*) is the native quail of the region. Gambel quail, California quail, bobwhite, and pheasants have all been introduced into the regions surrounding the park. It is hoped that the scaled quail will maintain its range on the arid mesa, and that the exotics will not become established.

In general, the faunal picture at Mesa Verde is a favorable one. Just how much the vegetation and, consequently, animal life have been modified by the early years of cattle grazing and the adverse influences from outside the park is yet to be determined. With exception of the porcupine situation, there are no problems of conflict between animal life and human occupation. The chief difficulty at present lies in inadequate boundaries.

ZION CANYON

The topography of Zion National Park is such that the animal life enjoys a natural protection. The chief difficulties are in the surrounding region. About 60,000 head of domestic sheep are grazed above the park on the Virgin River watershed. This region has been grazed for more than 50 years. The forage is greatly injured, and the erosion severely accelerated. The effect of this grazing upon Zion National Park is evidenced in the enlarged and changing stream bed in Zion Canyon. Old farms which used to lie along the river have been washed away, and the floor of the valley has been cut away to a depth of 15 to 20 feet in many places. If the floor of Zion Canyon is destroyed—it is apt to be if the present tendency is not corrected—the park will be ruined, to say nothing of the damage already done to the winter range.

The greatest danger to wild life, however, is the destruction of the water supply. In overgrazed places the water rushes off the denuded mountain slopes with no time for percolation into the soil; then the water holes are dry when water is most needed. It is also destructive of fish and all other forms of life in the streams. Every effort should be made, in cooperation with the Forest Service, to limit and regulate this grazing above the park. In its present tendency the industry is suicidal, and the damage to the park and range will be irreparable.

Grazing of domestic sheep is carried on dangerously close to the east rim of the canyon, and there is some poaching upon the summer range in that portion of the park. It would be very desirable if the east boundary could be moved a few miles further east in order to give a more effective protection to the wild life of that region.

Within the park, a resident of Cedar City owns 540 acres near the Temple of Sinawava. This tract of private land is so vital to the

heart of the park that the owner has been given the privilege of grazing an equal portion of land in the northwest corner of the park, in the region of Potato Valley, in lieu of his grazing privileges on the Sinawava holding. The northwest corner of the park is badly overgrazed by sheep, and erosion is severe. Sheep carcasses have been strychnined and left in this portion of the park to poison predators, chiefly mountain lions. It is evident that such a situation is inimical to the wild life of the park. The private holding within the park should be acquired as soon as possible.

BROAD-TAILED BEAVER (*Castor canadensis frondator*).—Beavers were in the park when the region was first settled by the pioneers, but no beavers have been there in recent years. It has been suggested that they be reintroduced into Zion Canyon, along one of the west tributaries of the canyon, where they could have some seclusion and still be seen from the trails. The reintroduction of beaver, however, seems inadvisable because of the freshet character of the streams, due to overgrazing on the watershed, and because the narrow valley floor is now largely occupied by human developments.

MOUNTAIN LION (*Felis oregonensis*).—Mountain lions are controlled in the region around the park, and the park is scarcely large enough to protect them. The sheepmen in the region consider that the mountain lions in the sheep territory above the park, on the headwaters of the Rio Virgin, are park lions driven out of the park by highway blasting. A sheep herder of a lessee in the park said that on May 24, 1931, a lion killed six sheep two miles east of Potato Valley. Last fall the same sheep herder found two fawns killed in the same region, supposedly by lion. The herder poisoned the carcasses and left them. Ranger Russell reported that a mountain lion and two kittens had been killed in the northeast section of the park about March 1, 1931. Above the park, between Cedar Mountain and Zion, the sheepmen each fall distribute poisoned horse carcasses, but report that they do not get many lions in this way.

The very few mountain-lion depredations about which we could get information do not seem to warrant further control within the park.

ROCKY MOUNTAIN MULE DEER (*Odocoileus hemionus*).—Deer are plentiful within the park. We saw deer tracks in every section of the region traversed. There is a hint of possible complication for the future if the number of mule deer frequenting the canyon increases materially. Fifteen years ago Yosemite Valley had no more deer than Zion has at the present time. To-day the deer constitute an important problem, having done considerable damage to the flora of Yosemite Valley. Apparently the vegetation in Zion Canyon has not suffered as yet. By careful management such a situation may be definitely averted.

A few deer are killed each fall just below the south entrance to the park. Coyotes are few, and constant warfare is waged against mountain lions in the region. Consequently, the deer are increasing and can afford the losses around Springdale and Rockville, just south of the park, even though this is the natural winter range for park deer. Should the effect of hunting become too serious in this area, protective steps might need to be taken. No such measure seems necessary at present.²³

ROCKY MOUNTAIN BIGHORN (*Ovis canadensis canadensis*).—Mountain sheep are present in the park. They have been seen in bands numbering up to 18 along the Zion-Mount Carmel Highway, and are to be found in the valley behind Bridge Mountain. They are in protected country and seem to be maintaining themselves. However, there are some indications of poaching.

In general, range conditions at Zion have greatly improved since 1900. The outlook is favorable for most forms of wild life. Certain features, as outlined above, need adjustment, but any moves must be made advisedly, with due regard for the sheep industry of the region as well as for the park.

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²³ See p. 34.

ROCKY MOUNTAIN PARKS

Glacier, Rocky Mountain, Grand Teton, and Yellowstone are the national parks of the United States proper which are most important in the conservation of large numbers of big game. Grizzly bear, bison, moose, and American wapiti, otherwise threatened with extermination, have been preserved within their boundaries. A herd of American pronghorn is receiving full and adequate protection at present in Yellowstone. Glacier has the finest representation of mountain goats, and it is the only place where this strange inhabitant of the highest crags is seen by large numbers of people. Big-horns are found in other parks, but only in this Rocky Mountain group are they abundant and frequently seen. Here are the beaver parks and the places where such fur-bearers as badgers and river otters are actually observed by visitors.

The west side of Glacier is a rain forest and resembles Mount Rainier in the Pacific Coast group, but the rest are typical of the Rocky Mountain region in general character and in flora and fauna.

GLACIER

That part of the Selkirk Mountains from which Glacier National Park has been carved is exceptionally rich in wild life. The lavish flora provides varied and abundant food and there are a wealth of animal habitats. Before it was reached by civilization this region contained representatives of all the large game mammals of temperate North America, inclusive of antelope, bison, caribou, mule deer, white-tailed deer, elk, moose, mountain goat, mountain sheep, mountain lion, wolf, and grizzly and black bears.

The history of human development has been kinder here than in many other parks. The region was inaccessible and remained relatively unknown for a long period. Consequently, its rich fauna did not suffer long hard years of exploitation such as decimated that of Rocky Mountain before it was rescued for park purposes.

The other side of the story is that Glacier suffers from poaching to a greater extent than any other national park, and under such circumstances that it can not be justly stopped. Under present conditions, a majority of the transgressors have a moral if not a legal right to what they take. The whole question is greatly complicated by lack of winter range and by the large number of private holdings within the park. Each side of the park has conditions peculiar to itself, and the solutions to the problems of one locality are in no way applicable to the others.

To the north, where the international boundary is the park line, the outlook is very favorable. When the Waterton-Glacier International Peace Park²⁴ becomes established, a real opportunity will be provided for administration of the combined parks as one faunal area. The boundary cuts arbitrarily through the heart of mountains which, from every natural consideration, are a unit area. The favorite goat haunts, bottoms frequented by moose, and habitats where caribou are most likely to occur lie astride this line. As it is, the existence of Waterton Lakes Park has been a most fortunate circumstance for the wild life of Glacier. Much greater benefit would derive from the closer linking of the two as an international park, particularly as the favorable situation thus created might be expected to lead to a closer conformity of boundaries on the east and west.

The present eastern boundary of Glacier is also the west boundary of the Blackfeet Indian reservation. This line more or less severs the park game from its natural winter range on the Indian lands and cuts off the Indians from their ancestral food supply—the game in the mountains of the parks. The very designation of the boundary was the portent of trouble. Circumstance must take the blame. It would not be fair to place it upon either party to the conflict. Certainly the Indians who face starvation with the coming of every winter are not to be condemned if they step across the line and take for the gratification of hunger what the white man tries to conserve for the satisfaction of aesthetic longings.

From the park viewpoint there is no panacea for the wild-life problems along the eastern face. The boundary can not be pushed eastward to impinge much more heavily on the lands of the impoverished Indians. However, as an obvious administrative necessity it should be moved out to take in the small areas between its present position and the road which parallels this side from Glacier Park Station to the Canadian line. Such a boundary could be patrolled. It would be recognizable to everybody. All domestic stock could be effectively kept off park lands, thus giving the game the maximum use of winter forage within the park.

A second approach to the problem, and one which the superintendent has been ably forwarding, is that of conciliation of the Indians. In this undertaking he has become pioneer in a new and promising field. Looking into the future, the interests of park and reservation, far from being at variance, are seen to be surprisingly akin. It is to the greatest interest of the park that the Indians continue to contribute their presence with all the valuable appurtenances

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²⁴ Since this manuscript was prepared, the Waterton-Glacier International Peace Park has been established.

of their culture. They will degenerate and their arts crumble unless they can prosper and be self-sustaining. Hence the influence of the park should be directed in their favor wherever it is consistent with policy.

If the interest of these Indians can be stirred on the side of perpetuating the game for them and their descendants, and the danger of starvation among them can be averted, not only will they no longer be driven to poaching in the park but any that do transgress can be prosecuted with a free conscience. Best of all, the sympathies of their leaders will be with the law, without which there never can be effective enforcement.

The south boundary from Glacier Park Station to Belton is Theodore Roosevelt Pass, which follows these streams: Summit Creek east of the Continental Divide, and Bear Creek and the Middle Fork of the Flathead River down on the west side. The rule that streams make the poorest boundaries for wild life is nowhere better exemplified than here, where the railroad accentuates the evil. The whole length of the pass is occupied by the Great Northern Railway, and it can not be expected that all persons who travel have knowledge of national-park ideals.

Snows force the park game of this section down to the river bottom and the railroad, where it is greeted by poachers even before it crosses the line. Whereas the railroad practically limits the boundary from extension to its natural course along the crest of the Flathead Range and the headwaters of the South Fork of Two-Medicine Creek, the answer to this problem must be sought in a rigid system of patrol and perhaps feeding in an emergency to keep animals on the park side of the line.

On the west, the boundary follows the North Fork Flathead River from Lake McDonald to Canada. Again the disadvantage of bounding a faunal unit by a river which cuts through the winter range becomes evident, but this time there is another more immediate concern in the ranches which are privately owned and operated within the park.

These mountain ranches are not self-sustaining. The stock formerly ranged on the domain adjacent to the farms themselves, and the Park Service has been obliged to issue permits for the continuance of this practice. Not to do so would be to starve the ranchers out. Still, this use of the natural forage of the winter range has resulted in artificial feeding of the game, which is detrimental to the animals and a burden upon the park besides.

Further, these same ranchers were used to piecing out their living by utilizing the game for food in winter and by trapping for fur. It is not to be wondered that they have continued to reach for what

they once considered part of their right of homestead. For this reason it is hard to secure a conviction even if a poacher is apprehended in this district. Existence on these marginal farms was always slim and the coming of the park has undoubtedly made it more precarious. There never will be a satisfactory solution of the problem until these private holdings are extinguished. This should be done promptly in fairness to all concerned. Otherwise, either the game must continue to suffer because of the incomplete adherence to park rules or the ranchers must be unavoidably harmed because of strict enforcement of those rules.

If this situation can be cleared up, the river may serve at least passably well as a boundary because it happens that a large part of the winter range of its drainage is on the park side. It only remains to make the forage on this range in the park properly available to the park's game.

AMERICAN BISON (*Bison bison*).—Abundant skeletal remains place the range of the bison well within the limits of the park. A skull and a number of leg bones were found by a member of the party near the head of Red Eagle Lake. The bison was the principal factor in the economy of the Blackfeet Indians and without it the pageant of life on the east side is sadly incomplete.

As a project undertaken by the park alone, the bison could never be brought back except as a paddock display. But there is genuine hope of building up a herd in joint ownership which will range in the park in summer and on the reservation in winter. If the Indians felt that the bison belonged to them, too, and knew that the annual increase would feed them in winter and provide them with the buffalo robes so dear to their lives and even to their religion, they might well be expected to guard the herd jealously.

ROCKY MOUNTAIN BIGHORN (*Ovis canadensis canadensis*).—The status of this species is generally satisfactory though its numbers fluctuate from time to time. They are choice food and there is no doubt that the Indians take some toll from them each year. Unless there should be an alarming decline in the total mountain-sheep population of the park, it would seem unnecessary to take any more drastic step than to guard as carefully as possible against poaching.

Certainly artificial feeding should be avoided entirely unless it becomes an absolute necessity. One of the many likely consequences of this practice was manifested at Many Glacier during the winter of 1931-32, according to a report of the superintendent. A band of sheep was being fed hay by the keeper of the hotel. They were enticed by the feed to abandon their usual caution and their safe retreats, with the result that a number of them fell prey to coyotes. There is no end to the complications when wild animals are made dependent upon man.

MOUNTAIN GOAT (*Oreamnos americanus missoulae*).—This animal seems to be as secure in Glacier as could be desired. Its relationships in the matter of presentation to the visitor are ideal. Everyone who so wishes can see these strange creatures on the precipitous rocks that are home to them. Yet there is just enough uncertainty as to where and when to go to give zest to the chase. Exercise afoot or on horseback is required, and the successful hunters have stories to tell in the hotel lobby at night.

FIGURE 43.—A number of mountain sheep from this Many Glacier band fell prey to coyotes at the feed yard. This is one of the many complications resulting from artificial feeding. Photograph taken September 1, 1931, at Many Glacier, Glacier. Wild Life Survey No. 2394

AMERICAN PRONGHORN (*Antilocapra americana americana*).—Vernon Bailey²⁵ believes that antelope were originally present in this vicinity. There would be no likelihood of having them in the present park in a free state, and their presentation in an inclosure would be subversive of national park standards.

MOOSE (*Alces americana*).—Moose are not common in the park now, but, whereas they were very scarce a few years ago, they are reported by everyone as steadily increasing. The best moose country is on the west side in the vicinity of the private ranches discussed above. Their improving status is undoubtedly due to the

²⁵ Wild Animals of Glacier National Park, by Bailey, Vernon, and Bailey, Florence Merriam, 1918, p. 31.

decrease of poaching, but they still suffer somewhat from this cause. That they are still hunted was attested by their wildness when sought out by a member of the party. When the private holdings are eliminated, this problem will be solved and moose will undoubtedly become one of the familiar sights of the park.

AMERICAN WAPITI (*Cervus canadensis canadensis*).—As is the case in each of the parks where elk are found, the critical factor is one of winter range. There are two herds in the park which probably

FIGURE 44.—Mountain goats at Cracker Lake. Presentation here is ideal, as everyone willing to walk or ride can obtain views of this animal on the rugged cliffs that are its native home. Photograph taken September 3, 1931, in Glacier. Wild Life Survey No. 2071

intermingle in the summer in the vicinity of Triple Divide. The smaller St. Mary herd of the east slope, now comprising about 70 head, is in constant danger of being annihilated whenever a heavy winter forces the animals out onto the Indian reservation. This very occurrence brought about a slaughter a few years ago and the herd has not fully recuperated since. The situation would be greatly helped if all domestic stock could be kept off the winter range around St. Mary Lake in the park to restore its full carrying capacity for the native game.

The larger herd of elk, numbering perhaps 300, is in the Nyack district. It suffers from poaching along the railroad when it is

forced down from the heights in winter. These elk were found frequenting a lick on Coal Creek within 2 miles of the boundary in August. As suggested above, patrol will have to deal with this problem as well as it can. The boundary is bad for game and can not be moved to the top of the watershed to the south.

WESTERN WHITE-TAILED DEER (*Odocoileus virginianus macrourus*) and **ROCKY MOUNTAIN MULE DEER** (*Odocoileus hemionus hemionus*).—Both forms are found in the park in numbers, though the white-tailed deer are by far the commoner. The mule deer belong more to the interior high country and there is no question concerning their status.

The white-tails are the common deer of the west side, which contains many square miles of ideal habitat for their kind. At Logging Creek, where they are artificially fed, some 300 were reported in the winter of 1930–31. The reason given for this practice was the scarcity of forage due to heavy grazing of the range by ranchers in the park. As suggested above, there is only one real solution and that is to buy out the ranchers.

Even under present conditions there is question as to the advisability of the winter feeding, with its tendency to accentuate yarding of large numbers of deer, to concentrate coyotes, etc. The deer are, if anything, too abundant in this section, considering that the forage is used by domestic stock as well. If deer continue to increase, serious damage to the range may ensue. It would be better to keep their numbers even below normal to preserve the carrying capacity of their range until such time as the domestic stock is removed.

MOUNTAIN CARIBOU (*Rangifer montanus*).—Caribou can not be considered as a member of the Glacier Park fauna at the present time, its occurrence being limited to an occasional straggler in the Kintla district in the extreme northwest corner. Undoubtedly mountain caribou have frequented the area to a greater extent in the past, but it is the very fringe of their range. A few are still found in the United States further to the west in Montana and northern Idaho near the Canadian line.

There is little likelihood that this wandering animal of the north can ever be made a permanent resident of the park, but there is a hope that rigid protection in the adjacent national forests, including the Kootenai, Pend Oreille, and Blackfeet, will favor its increase in this country. If the Waterton-Glacier International Peace Park is established, a cooperative effort to improve the status of this caribou on both sides of the international boundary would be a worthy project. If successful, the mountain caribou might be a frequent enough visitor in Glacier Park to merit a real place in its fauna.

CANADIAN BEAVER (*Castor canadensis canadensis*).—That the beaver population is kept to the minimum, particularly on the west side, is evidenced by the large number of old workings and the very small amount of fresh cutting. Because of the manner in which they are taken, it can not be expected that poaching of beaver will ever be stopped until private holdings are eliminated, and an improved sentiment toward the park wild life is adopted by the inhabitants of the surrounding regions.

PREDATORS.—The status of these secretive animals in this park is not very well understood and should be carefully investigated. The coyote is abundant, probably more so than in primitive times. But if mountain lion, wild cat, Canada lynx, and gray wolf are no longer present in normal numbers, then the coyote is filling their place as the natural control of the herbivores and should not be controlled except in the event of an emergency. The ultimate goal should be to have all the native predators present in reasonable numbers, which would probably mean an increase of mountain lions, a restoration of that rare animal, the wolf, and a decrease of the coyote in proportion. The present situation should not be interfered with until adequate studies are made.

MUSTELIDS.—All members of this family should be encouraged and protected as carefully as possible, the more because they are persecuted everywhere outside the parks. Mink, marten, and weasel are probably safe. Badgers do not find suitable habitats in the park, though two were observed in an old burn on the west side near the North Fork Flathead River. The wolverine is probably gone. If it fails to come back it could be reintroduced some day. The fisher is native and may still be present, though no one could tell us anything about it. It is so insistently trapped and has become so rare in the United States that a valuable service would be rendered if it should come back in Glacier under rigid protection.

BLACK BEAR (*Euarctos americanus*).—Whereas black bears are fairly common, they are not encouraged to become tame. Hence there is no serious bear problem. On the other hand, they are thoroughly enjoyed by the visitors. For instance, when a bear appeared at McDermott Lake all the occupants of the dining room at Many Glacier Hotel rushed to the windows. Bears are most attractive when the contact is not too intimate.

GRIZZLY BEAR (*Ursus horribilis* sp.).—These occur at high altitudes and are rarely seen even by the rangers. This is the only park in the United States besides Yellowstone where this vanishing species is found, and it should be jealously guarded.

TRUMPETER SWAN (*Cygnus buccinator*).—Though trumpeters nested in this part of Montana until very recently, no suitable nesting

lakes were seen within the park boundaries. One of the few specimens of trumpeter swan in existence is from St. Mary Lake,²⁶ but the park waters probably never figured except in the migrations of this species. It can not be hoped that Glacier Park will be one of the places where the trumpeter can be saved.

SANDHILL CRANE (*Grus canadensis tabida*).—The sandhill crane has gone from the park as a nesting species. Its return is most unlikely.

FISH-EATING BIRDS.—This question has been discussed in relation to Glacier on pages 65–66.

ROCKY MOUNTAIN

Rocky Mountain is another of the mountain-top parks. The failure of the east boundary to provide winter range was discussed as a typical example of this class of problem on pages 40–41. A similar situation exists on the west side of the park.

The west boundary, until recently, lay along the Colorado River, which is no more than a mountain brook a few feet across at this point. Deer and elk naturally drifted down the Colorado River valley in the fall, where they were easy prey during hunting season. The river could be easily crossed and was no barrier. It was like having stock in an open field, in one-half of which they were protected and in the other half of which they could be shot. A portion of this boundary has been improved by extending it to the crest of the Never Summer Range on the west side of the Colorado River. This mountain crest is a natural barrier to the wild life of the park. However, the Never Summer Range extension covers only about one-third of the western boundary. To complete the protection of the winter range on the west side of the park, the west boundary should be continued from the crest of the Never Summer Range south along the crest of Parika Peak, Cascade Mountains, and the Blue Ridge, to include the sage flat down by Table Mountain. The sage flat country would serve as the "lowest zone inhabited by the majority of the park fauna" in this section of the park. Of course, members of the mountain fauna may have migrated farther down the valleys on both east and west sides of the park in earlier days, but the extensions outlined here for both sides of the park would greatly alleviate the present unsatisfactory condition.

The protest is apt to be made at this point that the process of establishing natural boundaries, as outlined above, is a vicious logical process without an end. That is, the boundary was first along the Colorado River, then it was moved to the crest of the Never Summer Range in order to protect the fauna along the Colorado

²⁶ Life Histories of North American Wild Fowl, by Bent, Arthur Cleveland. United States National Museum, Bulletin 130, 1925, p. 295.

River; next, there would be a clamor to extend it to the west base of the Never Summer Range in order to protect the fauna of the Never Summer crest, and so on ad infinitum—or as long as anyone wanted to enlarge the park. It would be argued that whatever boundary was ultimately chosen would be an arbitrary choice, and, therefore, why not be satisfied with the present arbitrary boundary?

While it is true that any boundary chosen is an arbitrary boundary, the only justifiable arbitrary boundary is one which follows a

FIGURE 45.—Accelerated erosion is one of the harmful effects of overgrazing. In this valley of Estes Park, the fertile bottom is being carried out bodily and at a rapid rate. Photograph taken June 22, 1931, in Estes Park, Rocky Mountain. Wild Life Survey No. 1992

natural boundary. Nor is this a vicious process of territorial acquisition. Its purpose is to adequately safeguard the park fauna as the minimum cross-section of a biological unit which can be safely maintained. Beyond that, there is no need for further extension along the arguments just developed.

The necessity for extending park territory in certain places is not limited to the need for winter range alone. It is closely tied up with all the difficulties arising from influences external to the parks. In areas so small as our individual national parks, unless they are adequately protected by natural boundaries it is impossible to preserve the species blacklisted outside. It is impossible to preserve the

valuable fur-bearers. It is impossible to check the encroachment of exotic species or to preserve intact the species native to the park. In fact, the nature of boundary difficulties is of such fundamental character that without adequate territory in our national parks and proper natural boundaries to protect them the whole national-park project must fail to fulfill its purpose.

BLACK BEAR (*Euarctos americanus*).—Black bears are increasing in the park. With their increase in numbers and further development of the region for summer homes, their depredations are bound to increase. There has been no problem in the past because bears, as well as many other forms of wild life, were almost exterminated in this region 30 years ago. Under park protection the wild life is coming back, and in its old haunts summer homes and commercial developments are to be found. It is inevitable that difficulties will arise where bears and elk are placed in the highly complex and fragile environment of the summer resort. Houses and fences are flimsy; they are not built to withstand the attacks of bears and elk. People are not accustomed to these wild animals in their civilized communities, and they do not know how to defend themselves under such unusual circumstances. For the future there seem to be but two courses from which to choose—either bears and all other large animals must be kept to the minimum or else the private holdings in the heart of the park must be acquired and converted into natural park territory. If a national park is to be there at all, the latter course is the only justifiable one as well as the only ultimate solution. Other reasons for the acquisition of this territory have already been presented in the discussion on providing adequate winter range.

Fortunately, there is no bear feeding at Rocky Mountain, and the bears are still wild. It is hoped that this condition can be maintained.

GRIZZLY BEAR (*Ursus shoshone*).—(The type locality of this grizzly is Estes Park, but there may have been other forms in the park.)

The grizzly bear is probably gone from this region. There has been a recent report, unconfirmed, that grizzly tracks were seen in the Never Summer Mountains in the northwest corner of the park. Under present conditions, it would be undesirable to reintroduce the grizzly bear, even if such were possible.

ROCKY MOUNTAIN MARTEN (*Martes caurina origenes*).—Martens are not scarce in the park, but they need absolute protection from poaching. Trap lines have been found within the park, and martens actually found in the traps. Poaching is persistent in Rocky Mountain and will be difficult to eliminate completely.

FISHER (*Martes pennanti pennanti*).—There is no record of fisher. Probably the park is south of its range.

WOLVERINE (*Gulo luscus*).—See pages 44–46.

OTTER (*Lutra canadensis* sp.).—Otters may have been transients in the park at one time. They are gone now. There are records of their having been taken at various points throughout the State, including a record near Grand Lake, but nowhere in Colorado have they ever been abundant. The reason for this scarcity is not definitely known. But with these facts in view, it would not seem advisable to attempt to reintroduce them in the park until more definite information is gathered concerning their suitability to the region.

TIMBER WOLF (*Canis nubilis*).—In former years wolves were abundant throughout the State. For many years they have not been seen or heard of in the park. Recently, a few reports from various sources would indicate that perhaps a few have persisted or migrated into the park. All carnivores, except weasels and coyotes, are very scarce in the park, for which reason the wolves, if present, should not be discouraged.

MOUNTAIN LION (*Felis oregonensis hippolestes*).—Mountain lions have been systematically hunted in the region for many years. Perhaps a few remain. There has been a double bounty paid for mountain lions, amounting to \$75 per head. Given the complete protection of the park, they should be able to reestablish themselves over a period of years. It should be noted here that the park administration has carried out no control of predators for many years, and is in full accord with the desire to have them invade to the carrying capacity of the range.

CANADA LYNX (*Lynx canadensis canadensis*).—We could get no recent records of lynx in the park, although they were abundant at one time throughout the high mountains of the State, even south into the San Juan and Sangre de Cristo ranges. They have been greatly reduced—a few may still remain in various parts of the State. They belong naturally in the park fauna. The problem at present, however, involves the status of all the other high mountain forms of life—valuable and scarce forms such as grouse, ptarmigan, mountain sheep, and snowshoe rabbit. It is not known why ptarmigan and grouse, for instance, are so scarce. However, the present status of the lynx in the park must be reckoned as a change from the original picture.

GROUND SQUIRREL (*Citellus elegans*).—This little ground squirrel has profited by civilization to the extent that it has invaded the Estes Park country by the thousands. It has become a nuisance around buildings, gardens, and in fields, and appears to be displacing the native and more colorful golden-mantled ground squirrel (*Callospermophilus lateralis*). This is one of the outside factors affecting the park fauna and should be thoroughly studied for solution.

BROAD-TAILED BEAVER (*Castor canadensis frondator*).—Beavers are abundant throughout Rocky Mountain National Park. They cause no difficulty except where they obstruct the local water supply on one of the private holdings. One private resort trapped six beavers from its domestic water supply three years ago, and has had no difficulty since. While this is not exactly in accord with park aims, it is obviously necessary where private holdings are within the park. It is only one of the complications which ensue so long as a park embodies private lands within its boundaries. This type of difficulty arises from the inadequacy of the park rather than from the presence of the animal itself.

FIGURE 46.—Many different forms of wild life, ranging from small aquatic insects to waterfowl, muskrat, mink, and even moose, follow the successional habitats produced by the beaver cycle. Photograph taken July 13, 1931, at Jackson Hole, Wyo. Wild Life Survey No. 2130

Another problem which has arisen is in connection with the presentation of animal life. Beavers have been present in Hidden Valley for at least 30 years. Recently, the new Transmountain Highway has been developed through Hidden Valley, passing the beaver lakes en route. This provides an excellent opportunity for visitors to see beaver colonies from the highway. It so happens that the beavers have nearly exhausted their food supply—the aspens and willows—by their lakes. In a few years they must desert these lakes by the new highway and go elsewhere. The opportunity of seeing these particular beavers will be lost to thousands of visitors. Only the dried and revegetating lake beds will remain to tell the story.

It has, therefore, been suggested that the beavers be limited to one family in order that the food supply may be adequate to maintain them, and that they may always be present to be seen from the road.

If the suggestion is worth making, it is worth considering.

A beaver is not just an animal which builds houses and dams. It is an animal which moves into a region, increases in numbers until it exhausts its food supply, then moves elsewhere. Vegetation gradually reinvades the deserted pond, and the whole cycle of plant succession is repeated until suitable beaver food is once more produced, beavers move in again, and the whole cycle starts over. This

FIGURE 47.—Beavers at Hidden Valley have utilized the aspen near at hand and now travel a well-beaten path to a more distant grove. The farther they must go overland the greater the exposure to natural enemies. It is at least possible that the balance between population and food supply is assisted by this relationship. Photograph taken July 1, 1931, in Rocky Mountain. Wild Life Survey No. 1823

is the way much of our meadow land has been formed. Many different forms of wild life, ranging from small aquatic insects to waterfowl, muskrat, mink, and even moose, follow in succession the changing habitats produced by the beaver cycle. No individual phase of the beaver cycle is more destructive or more climax than the rest; it is a continuous chain of plant and animal succession, each phase of which leads naturally to the succeeding steps; any one moment in the cycle signifies all the rest. It is this marvelous change, variety, and orderly succession of nature which makes nature what it is. It is this for which man comes. It restores in him a certainty, which he needs. This is recreation, and it is the

great value of the national parks. While this may seem a long step from the beavers of Hidden Valley, they nevertheless are an integral part of the complex chain, and they have been considered so important a part that it has been suggested that they be changed and controlled for the sole purpose of enhancing their value in the chain. But if they were controlled, there would be nothing left except the interesting animal which builds houses and dams in its picturesque lake—a new thrill on the new mountain road. If there is to be any permanent value in our parks, they must be allowed to run their orderly succession of change which produces the marvelous variety of life.

AMERICAN WAPITI (*Cervus canadensis canadensis*).—The elk situation has been presented, pages 40–41.

One other range extension, treatment of which was not necessary to the former discussion, is suggested here. About 100 elk summer above Cow Creek Canyon and winter on the ranch and below it. If the park boundary were extended to include the ranch and about 3 miles of the valley territory south of the ranch, this would be the one place along the east side of the park where the necessary winter range could be provided without bringing elk around the centers of human habitation.

ROCKY MOUNTAIN MULE DEER (*Odocoileus hemionus hemionus*).—The deer winter range is so closely related to the elk winter range that it needs no further treatment here.

AMERICAN PRONGHORN (*Antilocapra americana*).—Antelope ranged up into the foothills and mountain parks in the past. The fringe of their range may have extended into the present park territory, but there seems to be no suitable all-year range for them within the park at present.

BISON (*Bison bison*).—Skulls have been found even up to timberline in the park. There would be no possibility of maintaining bison on the present limited range of the park. They are also gone from the original faunal picture of the park.

ROCKY MOUNTAIN BIGHORN (*Ovis canadensis canadensis*).—See pages 51–52. The mountain sheep of the park are adequately protected. They have suffered heavily from scab in the past, and some of them appear to be still infected. Their situation needs careful investigation. They seem to be maintaining themselves.

In general, Rocky Mountain is a park which suffers greatly from problems due to early influences, problems of geographical origin such as improper boundaries and inadequate winter range, and problems of human and animal conflict. Yet it is a park with tremendous possibilities for faunal development. But before these possibilities can be fully realized, the boundary adjustments will

have to be made, and the private holdings eliminated. Even one last unfortunate claim must be removed some day, and that is the canal which takes the normal supply of water from the Never Summer Mountains and Specimen Mountain so that even fishing is spoiled in the streams below.

YELLOWSTONE AND GRAND TETON

These two parks are treated together because their animal problems are not separate. It is to be greatly regretted that Yellowstone when originally established did not include the Thorofare Plateau and the intervening territory to the Teton Mountains, as well as sufficient winter range on both north and south sides of the park. Perhaps this seems an extravagant concept. But let it be recalled that Jasper Park in Canada has an area of 5,380 square miles—the approximate equivalent of Yellowstone, Yosemite, and Grand Canyon national parks combined. More than this, Jasper is contiguous with three other national parks, forming, in reality, one large park with an approximate area of 10,000 square miles, extending continuously along the Canadian Rockies for a distance of over 250 miles. There is not one national park in the United States which provides adequate range for its animal life. In a country expanding and developing as fast as ours there is great need for at least one area which will be adequate to protect and maintain a sample of our native wilderness life as a national heritage for all time.

The wild life of the Yellowstone-Teton area could be served best if the park were composed as follows:

From Eagle Peak, continue the east boundary of Yellowstone along the crest of the Absaroka Range to the point at which the Wind River highway, U. S. 87-W, crosses this crest; follow said highway westward to the Buffalo Fork of the Snake River; follow Buffalo Fork westward to the west boundary of the Teton National Forest; then continue southwestward along the west boundary of the Teton National Forest to a point approximately east of the southmost point of Grand Teton National Park; then west to the Idaho-Wyoming boundary, and north along this boundary to the Bechler River corner of Yellowstone Park.

In addition to the present Yellowstone and Teton Parks, this unit would include the Thorofare Plateau, the intervening summer game range west to Jackson Lake; the great wild fowl and moose breeding grounds in the Jackson Lake region itself, and would provide protection for fur-bearers and winter range for mountain sheep in the Tetons. More than this, it would provide one park unit in the United States sufficient in area and habitats to maintain the forms

FIGURE 48.—One of the newest parks takes steps to prevent destruction of the natural lake shores. Note old auto tracks now cut off by log barriers. Photograph taken July 9, 1931, at String Lake, Grand Teton. Wild Life Survey No. 1920

of animal life which can not exist anywhere else nor under any other conditions.

For many years the absolute necessity of providing winter range on the north side of the park has been so apparent that there is no need of treating it here. It is to be hoped that the purchase of this winter range will be consummated without delay because of the pressing need for winter forage and the maladjustments resulting from congestion of game at the present feeding stations.

It would be useless to detail each species of animal in the park—more has been published about the wild life of the Yellowstone

FIGURE 49.—In our experience, the grizzly will not leave its path to harm a human being; neither will it brook interference with its family life. Photograph taken September 13, 1929, at Canyon Lodge, Yellowstone. Wild Life Survey No. 509

region than for any other park. The main types of faunal problems affecting the park as a whole have been treated throughout the previous part of this report. In fact, there is not a single type of problem discussed thus far which does not apply to Yellowstone. Nowhere in the national-park system is the unit character of the area more evident. To make the park coextensive with this unit faunal area would be to remove the fundamental cause of most of the difficulties. Then there should be a thorough investigation of the status of each species to determine the immediate factors operating to the detriment of the animal, and to devise means of correcting them. Of course, the problems of conflict between man and animal would still persist, though not to the same extent. To outline every type of faunal problem in Yellowstone would be to recapitulate

discussion which has gone before. But an indication of the most immediate work to be done might be advantageous.

The bear problem was outlined, pages 68-70 and 82-84. In accord with the suggestions given there, an investigation is to be inaugurated.

The fur-bearers can be advantageously treated as one problem. The status of the wolverine has already been outlined (pages 44-46), but there should be a thorough investigation of all the factors affecting the fur-bearers of the two parks to determine whether they are increasing or dwindling, and why; what effect they have upon rare wild fowl of the parks; whether they themselves need assistance or whether they are menacing some other form of life which is in danger of extinction (for instance, sandhill crane or trumpeter swan). In general, the fur-bearers' plight should be known thoroughly in order that they may be maintained in their normal position among the fauna of the region.

The spread of the coyote has already been treated (pages 47-49) and its present control in Yellowstone advocated. However, there is need of definite information about the coyote to know exactly what it is doing to the rest of the park game, i. e., the extent of its winter kills, its menace to all ungulates and ground-nesting birds during breeding season, whether it is responsible for the precarious status of antelope and mountain sheep in the park, whether it is displacing other fur-bearers, or whether its damage is greatly over-estimated. The complete rôle of the coyote in relation to the park fauna should be definitely known as soon as possible.

The wolf is gone; but if suitable range and protection could be procured for all native animals of the park, the wolf might then have a place.

Mountain lion and lynx have been controlled in past years until their present status is doubtful. The same investigation outlined for the coyote should be undertaken in relation to mountain lion and lynx, with the view of determining exactly what their status is in order that any further management may be conducted advisedly.

The white-tailed deer is gone. Before any attempt is made to bring it back, there should be thorough study of its habitat in and near the park. If the park was only the fringe of its range, it might be very unwise to attempt to reestablish it unless it could be self-sustaining, or until enough of its range could be procured.

Elk, deer, sheep, and antelope, as well as the buffalo, are all sustained in winter by artificial feeding. The undesirable phases of this practice and the possibility of its harm to the animals have already been pointed out. Nevertheless, winter feeding is absolutely necessary as a present emergency measure and until adequate winter

range is provided. The present available winter range already shows unmistakable signs of overgrazing. It would be inadvisable under these circumstances to increase the elk herds until range conditions can be improved. The carrying capacity of the range must be ascertained and the elk held within this limit. Mr. M. W. Talbot, senior forest ecologist, California Forest Experiment Station, and Mr. George F. Baggley, chief ranger, Yellowstone National Park, have both pointed out the necessity of an immediate range reconnaissance being conducted in the Yellowstone winter-range area. With the original character of the range becoming more obscure each year, the urgency of this investigation can not be overemphasized.

FIGURE 50.—Canada geese adjust themselves readily to man's presence in Yellowstone and flourish in large numbers. The wary sandhill cranes, on the contrary, shun the developed sections. Photograph taken September 18, 1929, in Lamar Valley, Yellowstone. Wild Life Survey No. 385

Concerning the animals themselves, Mr. W. M. Rush, formerly in charge elk study, and Mr. O. J. Murie, biologist, Bureau of Biological Survey, have both conducted extensive investigations of the elk herds in the region. But further research is necessary to determine the factors limiting mule deer, antelope, mountain sheep, and moose in these two parks. Especially is the status of the latter three obscure. They are so rare over most of their former range in this country that their protection in this region is vital. The mountain sheep of the Tetons, according to Superintendent Woodring, normally range on the west side of the peaks because the prevailing winds keep this side free from snow. However, this area is occupied by domestic sheep, and the mountain sheep are forced to

exist in the remaining unsuitable range. If the Teton boundary extended to the Idaho line, as has been suggested, this unfortunate situation would be corrected.

The status and investigation of the trumpeter swan is outlined, pages 28-31.

Five pairs of sandhill cranes (*Grus canadensis tabida*) were seen in the region last summer. Two pairs were known to nest in Yellowstone Park. A nest with two eggs was found in the Bechler River region, and a pair of adult cranes with one young were seen

FIGURE 51.—The pronghorn stands on the horizon in Yellowstone. At present it barely holds its own under adverse winter range conditions. Photograph taken June 26, 1930, at Lamar River, Yellowstone. Wild Life Survey No. 852

by Tern Lake. This is by no means a complete census, but it is at least a definite record. The same research outlined for trumpeter swans should be conducted for sandhill cranes.

The problem of the American white pelican in Yellowstone has been outlined, pages 78-79. There should be a complete investigation of the fish-parasite relations in Yellowstone Lake. Notable work has been done by Maurice C. Hall, Henry B. Ward, and Lowell A. Woodbury. But the importance of mergansers, ospreys, gulls, cormorants, grebes, bears, and other fish-eating animals has not yet been determined in relation to the pelican problem. Further work needs to be done. After all, the parasite problem might not be solved by removal of pelicans from Molly Island.

PACIFIC COAST PARKS

Crater Lake, Lassen Volcanic, Mount Rainier, General Grant and Sequoia, and Yosemite are the national parks of the high mountain ranges that fringe the Pacific Ocean. Except for Mount Rainier, which is in the humid north coast belt and is consequently clothed with dense rain forest, the parks of this group have striking biotic similarities. This in turn is due to broad similarities in geography and climate.

Coastal forms occupy their gentle western slopes, which have a moderate and moist climate because of exposure to oceanic influences. The eastern slopes of these mountains are more rigorous in every aspect. The escarpments are precipitous. Temperature fluctuations are extreme and the country is arid. In short, the eastern slopes are typically Great Basin, and Great Basin forms predominate.

The faunal problems of all parks in this group are alike: First, because many of the same species are concerned; second, because the history of human development has been much the same for all of them; third, because they show the same geographic limitations in failure to include the lowest life-zone occupied by their faunas; and, fourth, because they are all subject to the same type of development for human use.

This last consideration has important connotations. In the relationship between wild life and visitors, these parks, if Mount Rainier is again excepted, have a distinctive function in the whole national-park system. Dry, mild summers in combination with open park-like forests and frequent water courses make them paradises for life out of doors. Here the visitors go to spend, not days, but many weeks where they can camp in cool retreats and hike everywhere without need of elaborate equipment to make life supportable.

The significance of this as regards this problem is that it makes for intimate contact with wild life. Maximum opportunities are presented for securing the native values of wilderness life for the people. Concomitantly, there is danger that the wild life will suffer in proportion that visitors are not confined to a few development areas but swarm at will throughout the animal habitats.

This situation has made the dual function of the educational branch in presentation of wild life very important in these parks. The opportunity for intimate presentation of wild life is unparalleled, and the necessity to counsel the visitor in comporting himself so as to cause the minimum disturbance of its natural balances is equally great.

CRATER LAKE

Crater Lake is a mountain-top park, approximately 16 miles square. Its geographical situation concerning faunal requirements is almost identical with that of Mount Rainier. There is no winter range for park animals, and the boundaries include no natural faunal unit.

To correct this situation, the boundary should be adjusted as follows: Beginning at the present north boundary, extend the boundary from Desert Ridge northwestward to Bear Butte; follow the mountain crest between the Rogue and Umpqua River drainages southwestward to Whaleback Peak; turn south-southeast following the ridge to Luck Mountain and to the northwest corner of the Rogue River Lumber Company's holding; follow the company's boundary east and south to a point due west of Bessie Peak; continue eastward past Bessie Peak to Goose Egg; then turn northeast, following the Goose Egg ridge about 2 miles to the present south boundary by Pumice Flat. Such an extension would include enough of the Rogue River drainage to provide winter habitat for the park fauna, with the added protection of a mountain crest to further set apart such a faunal unit from outside influences.

The present park boundary is laid out very much as a national monument; that is, simply a line drawn around one thing of interest—the crater itself. This is true of Mount Rainier and Lassen Volcanic also. According to citizens who have been in the Crater Lake region since 1870, the country was rich in animal life before civilization destroyed it. There is still time to bring back this valuable heritage and make of Crater Lake National Park a magnificent wild-life retreat. With its wonderful hemlock forest and the incomparable crater, it should become once more the teeming wilderness of pioneer days.

BLACK BEAR (*Euarctos americanus*).—The encouraging feature about the bear situation at Crater Lake is that natural food is abundant. Consequently, no artificial feeding of bears is necessary in order to keep them in the park or to have them seen by visitors. They may be seen often along the trails and roads, which is, perhaps, the ideal presentation of animal life—a natural one without harmful consequences to either man or animal. The present limited park area, however, will not be sufficient safeguard for bears as the surrounding territory becomes more intensively utilized.

GRIZZLY BEAR (*Ursus klamathensis*).—Judge Colvig, of Medford, Oreg., who has been in the Crater Lake region since 1863, says that grizzly bears were abundant in the Rogue River valley, ranging even up into what is now the park. The last grizzly, "Club-foot," was

killed in the "early seventies," according to Judge Colvig. This member of the park fauna is gone permanently.

PACIFIC MARTEN (*Martes caurina caurina*).—Pacific marten have been seen in the park each winter. However, they may roam many miles, and are not sufficiently protected in the narrow confines of the park. The late Chief Ranger William C. Godfrey reported evidence of poachers' trap lines inside the south and west boundaries of the park. Aside from the need of more protected territory, the greatest present need of marten, and all fur-bearers in the park, is immunity from winter trapping. The park needs winter patrolling.

PACIFIC FISHER (*Martes pennanti pacifica*).—Fisher are said to be present in the park, but are rare. They also need added range and strict winter protection.

WOLVERINE (*Gulo* sp.).—We could get no evidence of wolverine in the park.

OTTER (*Lutra canadensis*).—Otter used to be in the Rogue River drainage just west of the park, and may have been up in the park. Judge Colvig reports that the Klamath Indians used to sell otter skins which they had procured in the Crater Lake region. With sufficient refuge, otter could return to this region.

CASCADE RED FOX (*Vulpes cascadiensis*).—The foxes of Crater Lake are said to be mostly of the "cross" phase. Their fur is valuable, and they will need protection if they are to remain in the park.

COYOTE (*Canis lestes*).—Coyotes are numerous, but have caused no difficulties yet.

TIMBER WOLF (*Canis gigas*).—Several of the early inhabitants informed us that timber wolves used to be abundant in the Crater Lake region. Probably they are gone, but it is not impossible that a few remain in the Cascades which, if given sanctuary, might be a part of the fauna in an enlarged Crater Lake National Park.

MOUNTAIN LION (*Felis oregonensis oregonensis*).—Mountain lions have been so persistently hunted that they are rare in the region. There has been no sign of lions in the park for several years, to our knowledge. It would be impossible to keep mountain lions in the present park confines. Yet to lose it entirely from the park fauna would be very undesirable.

BEAVER (*Castor canadensis pacificus*).—Beaver were at one time abundant in the Crater Lake region. Judge Colvig recalls seeing beavers at Annie Spring on his first trip into the park in 1863. They are reported to be west of the park along Copeland Creek. A few migrated into the park, moving up Copeland Creek, in the summer of 1931, but their ponds were deserted when seen in the latter part of September. If sufficiently protected, they should flourish in the Rogue River area, where there is an abundance of food.

COLUMBIAN BLACK-TAILED DEER (*Odocoileus columbianus columbianus*).—Deer are not abundant in the park. Early inhabitants say that they have increased somewhat in the last 10 years, but that they are far below their former numbers. There is no winter range for deer in the park. With the first snow they migrate down into the Rogue River valley, wintering mainly above Prospect. In seasons of early snow this migration exposes them to hunting outside the park. The deer situation can not be improved until the upper Rogue River valley is protected. If it were made into a game refuge, the deer would profit, but that is not sufficient assurance for all the other forms of animal life. It should be made a part of Crater Lake National Park, to insure the safety and perpetuation of the wild life of the region.

ROOSEVELT ELK (*Cervus canadensis occidentalis*).—Elk (very probably the large Roosevelt elk) used to roam the entire Crater Lake region, according to early reports. They were practically gone by 1875. Occasionally elk are seen in the park, but these are American wapiti transplanted from Yellowstone Park. In July, 1929, Chief Ranger Godfrey saw five elk on Sun Creek, and in October he saw one near the Pumice Desert. On September 15, 1930, he saw three elk along the south boundary. With sufficient territory, it might be possible to reintroduce the Roosevelt elk, but with the present boundaries nothing can be done.

The foregoing brief account gives some idea of the faunal complications at Crater Lake, and the necessity of extending the boundary as outlined. It is hoped that the value of such a wild-life sanctuary will be fully appreciated. Further extension to include the Diamond Lake area does not appear to be necessary from the wild-life standpoint.

LASSEN VOLCANIC

Lassen Volcanic National Park, like the two parks to the north of it, describes a limited area of high altitude. Like them, it is only half a park where wild life is considered. It is approximately 16 miles long by 10 miles wide. Complete sanctuary is offered only to those animals which remain in the upper life zones through the snows of winter, and even some of these disappeared in the early human history of the region.

Not only is the total area far too small for any degree of biotic independence, but it is deeply dissected by private holdings which occupy the critical bottomland habitats. The isolation of this mountain-top park is emphasized by the intensive utilization of all surface resources of the lands adjacent to the boundaries on every side. There is nothing approximating wilderness contiguous with park lands at any point.

Grazing is intensive on all sides. Lumbering operations are heavy on the east. The region is heavily trapped. The whole country is very accessible, being crisscrossed by roads which reach up from the populous Sacramento Valley near by. Every attractive locality has its vacation resort, and in the deer season the concentration of hunters is amazing.

As a first conclusion, it would seem that the maximum usefulness is being obtained from the whole area under the present set-up. However, a thorough and fair-minded investigation might demonstrate that boundary adjustments to add a few critical areas would permit the park to become an effectual game refuge that would function in the perpetuation of the wild life of that whole countryside. If so, every landowner would feel the benefits. Already they owe much to the presence of a nationally maintained and advertised playground in their midst.

Vertebrate Natural History of Lassen Peak Region,²⁷ has given us a scientifically accurate and complete index to the life history and, particularly, the ecological relationships of the animals of this section. With this basic work accomplished it is now necessary to study the human relationship and interpret this material in the light of national park objectives. A few of the faunal maladjustments apparent even in the brief view of the park obtained in a single visit are mentioned here.

WATER BIRDS.—There are a number of shallow lakes, particularly in the northern half of the park, which are the breeding localities of some of the rare nesters in California, such as Canada goose, common loon, bufflehead, and possibly Barrow's golden-eye. Arrival of campers and fishermen during the incubation period means the abandonment and eventual loss of these breeding grounds. This situation should be investigated to determine what lakes, if any, should be closed to entry during the critical period in early spring. The problem should be studied now when an intensive fish-planting program is under way in case it should be found advisable to refrain from stocking certain lakes as the best way to preserve their unusual value for nesting wildfowl.

BLACK BEAR (*Euarctos americanus*).—Though present in the vicinity, according to reports, black bears are extremely scarce. Mr. A. Sifford, of Drakesbad, reported that a mother and cubs were photographed north of his place in 1930. Though it is probable they were more abundant in primitive times, there is nothing that the park can do to hasten their increase.

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²⁷ Vertebrate Natural History of a Section of Northern California Through the Lassen Peak Region, by Grinnell, Joseph, Dixon, Joseph, and Linsdale, Jean M. University of California Press, Berkeley, Calif., 1930.

KLAMATH GRIZZLY (*Ursus klamathensis*).—Grinnell, Dixon, and Linsdale state that this bear must once have occurred widely within the Lassen section, but not even a fragment of a specimen from there is known to have been preserved. This grizzly is extinct—a permanent loss from the park fauna.

FUR-BEARERS.—Trapping in the surrounding territory is so insistent that fur-bearers are scarce. Even the coyote has been kept down so well that the complaints so frequent elsewhere are not heard in Lassen. Only the trappers complain, and they because predatory-animal control in the interests of stockmen has been so effective that the coyotes have failed them as a means of support in winter.²⁸ Wolverines are not known to have been present. Fishers were certainly present once, but may be considered as absent from the native fauna now. Ranger R. N. Book is authority for the statement that martens were common near Summit Lake in 1927, but that trapping in the vicinity subsequently caused their reduction. It is possible that river otters still frequent the park. The story of the other fur-bearers is much the same. They are either gone or are very rare. There is no hope for them in this small park with the persistent trapping and the control work carried on outside.

MOUNTAIN LION (*Felis oregonensis californica*).—An occasional mountain lion may range in the park. The problem in this case is the same as for the carnivores discussed above.

COLUMBIAN BLACK-TAILED DEER (*Odocoileus columbianus columbianus*) and **ROCKY MOUNTAIN MULE DEER** (*Odocoileus hemionus hemionus*).—The following is quoted from field notes taken during a circle around the park in September, 1931:

“Hunting is very heavy everywhere outside the park boundaries. We saw hunters and hunters’ camps everywhere and many deer hanging up. The greatest concentration noted was along the east side and the south side from Warner Valley to Juniper Lake and out to Chester.”

Superintendent Collins told us that deer moved into the park in numbers during the hunting season and that 82 had been seen in one place recently. Our own observations bore out these statements. Thus the park may be in part responsible for the increase of deer in this section in recent years, though the chief factor is probably the improvement in California game laws and better enforcement which has resulted in a return of the deer in many sections of the State. Both mule and black-tailed deer will probably continue in the park;

²⁸ Vertebrate Natural History of a Section of Northern California Through the Lassen Peak Region, by Grinnell, Joseph, Dixon, Joseph, and Linsdale, Jean M. University of California Press, Berkeley, Calif., 1930, p. 473.

but so long as winter range is not included, their fate will rest with conditions obtaining outside.

According to one of the rangers, there is still difficulty in keeping hunters out of the northeast section, owing to the long freedom of the place which hunters have had. As patrols are perfected and the boundaries are better recognized, this problem will be solved.

LAVA BEDS BIGHORN (*Ovis canadensis californiana*).—This probably extinct species is not known to have ever occurred on Mount Lassen, and therefore is not a member of the fauna of this park.

White-tailed deer and antelope are animals which still occur a little further to the east; but if they were ever present in what is now Lassen Park, it was probably only sporadically or seasonally and, on present evidence, they can not be considered as belonging to the original fauna.

MOUNT RAINIER

Mount Rainier is another mountain-top park. It is approximately 18 miles square. Except for the east boundary which follows the crest of the Cascades, the park is laid out without regard for faunal requirements. It is therefore not a biological unit, and suffers from the usual faunal complications.

This could be largely corrected by extending the south boundary to include the Cowlitz River valley as far as Lewis; then swinging northwest to include Bear Prairie, by following the crest of Skate Mountain and the crest of the Sawtooth Range; then north to the Nisqually entrance. This would provide adequate winter range for the mountain animals which drift down into these valleys in winter. Other extensions of territory along the west and north boundaries would also be desirable, since it is evident that a park 18 miles square, with nearly a third of its area under perpetual ice, is much too small for a wild-life preserve.

The park is completely surrounded by modern highways, which destroy a great part of the inaccessibility and safety of the wild life of the region. There will be rapid drains upon the fauna of the park itself as the animal resources of the surrounding territory are decimated. The park wild life is in great need of added territory and added protection. Its own refuge should not be broken by further roads or developments. With reservations, this much might be said: There is a certain minimum of wilderness area below which some species drop out with further transections.

BLACK BEAR (*Euarctos americanus*).—According to park reports, the black bear is on the increase in the park, and its depredations are becoming more frequent. It would seem inadvisable, therefore, to augment this increase by artificial measures, such as the feeding of

garbage. Since the bear show is not intrenched in Mount Rainier as it is in some of the other parks, it is suggested as an experiment that there be no feeding of garbage to the bears of the park. Such an experiment might serve as a basis for comparison with conditions in other parks where artificial feeding is carried on. A special attempt should at the same time be made to bear-proof every source of food in the centers of human habitation, so that no food would be available to the bears in these areas. Possibly, constructive measures could be deduced from the experiment.

WOLVERINE (*Gulo luscus*).—This problem has already been treated on pages 44-46. It is important to add here, however, that the few

FIGURE 52.—A very few wolverines still linger around the Alpine fringe of Mount Rainier's ice cap, but the park area is too limited to insure perpetuation of this rare animal. Photograph taken October 4, 1930, in Yakima Park, Mount Rainier. Wild Life Survey No. 1301

wolverines of the park are in immediate need of added territory and absolute protection from poaching. The recent extension to the crest of the Cascades should improve this situation. The same is true for the other fur-bearers.

TIMBER WOLF (*Canis gigas*).—The last wolf seen in the park was killed in the Ohanapecosh section in 1911. Since that time there have been rumors of their presence. On September 30, 1930, we saw and measured wolf tracks on the Cowlitz Divide. Recently there have been other reports of wolf tracks seen in the park. It seems justifiable, then, to say that perhaps a few wolves still remain in the region, or have drifted in from elsewhere. Extension of the

park boundaries would insure greater protection for the few remaining wolves. There may also be a few wolves still present in the Olympic Peninsula.

MOUNTAIN LION (*Felis oregonensis oregonensis*).—Mountain lions are scarce in the park region. They have been much reduced in the past, and have a very small range within the park. In the winter of 1929–30, a family of five mountain lions was killed in the Cowlitz River valley between Lewis and the park. Lions are needed in the Mount Rainier fauna. They are now protected in the park, but, since their number is so reduced, they also need the protection of the proposed extension to the south.

PACIFIC BEAVER (*Castor canadensis pacificus*).—Beavers used to be in the park. "Dr. A. K. Fisher records that several beavers lived at Longmire Springs until 1896, when a trapper killed them all."²⁹ They are now around Longmire again.

APLODONTIA (*Aplodontia rufa rainieri*).—The little mountain beavers are abundant in and around the park, especially in the Bear Prairie region and in Stevens Canyon, where they have girdled and killed a few trees. Their chief nuisance is in their undermining trails.

They are a very ancient and primitive type of rodent, widely distributed at one time, now confined to a narrow strip along the Pacific Coast. It is not probable that they will ever be a serious problem in heavily forested areas, although they flourish in cleared areas and old burns such as Bear Prairie. Their value to the forest floor, and as interesting primitive remnants of an earlier fauna, make them especially desirable members of the park fauna.

COLUMBIAN BLACK-TAILED DEER (*Odocoileus columbianus columbianus*).—Deer are plentiful in the park. But their winter range is outside the park boundaries. Mr. Richard, district ranger at Ohanapecosh, said that deer drift down the Cowlitz River valley toward the junction of the Clear Creek Fork in winter. He has counted 23 deer within half a mile along the road in this area. The Cowlitz River valley in this neighborhood is occupied by mountaineers who believe in their primordial right to take game as they see fit. Consequently there is considerable winter killing of deer, and effective prosecution is practically impossible because of public sentiment. One individual is reported to hunt deer persistently here for the hides.

It is especially necessary that this region be included in the park, as outlined on page 126. Part of the area is covered with magnificent forest, worthy of a national park, and much of the rest is the

²⁹ Mammals and Birds of Mount Rainier National Park, by Taylor, Walter P., and Shaw, William T. United States Department of the Interior, 1927, p. 108.

picturesque Cowlitz River valley. This area is absolutely essential to the welfare of the Mount Rainier fauna.

AMERICAN WAPITI (*Cervus canadensis canadensis*).—Since 1912 elk from Yellowstone have been introduced into the national forests around Mount Rainier. They have greatly increased in numbers, and have strayed into the park from time to time. It is reported that some of the native elk were still present at the time the Yellowstone elk were brought in. It is very probable that the elk native to Mount Rainier were the Roosevelt elk—a larger, darker animal still found in the Olympics.

Any further introductions of elk in this region should be the Roosevelt elk. However, it seems that there is nothing to be done about the situation at present.

MOUNTAIN GOAT (*Oreamnos americanus americanus*).—Mountain goats are increasing in the park. This is very encouraging, and no complications have resulted yet or may be reasonably expected.

SEQUOIA AND GENERAL GRANT

There is no better commentary on the faunal changes wrought by man in and around our parks than the following quotation from Judge Walter Fry's *A Twenty-five Year Survey of the Animals of Sequoia National Park—1906–1931*.

"Bear and deer have increased at least 60 per cent. Mountain and valley coyotes, skunks, weasels, porcupines, pikas, rats, mice, gophers, moles, shrews, mountain beavers, and bats have held their own. Mountain lions, lynxes,³⁰ fishers, martens, minks, foxes, raccoons, ring-tailed cats, marmots, squirrels, chipmunks, hares and rabbits (other than the California jack rabbit) have decreased about 40 per cent. Mountain sheep, wolverines, and badgers are verging on extinction. Four mountain sheep were reported seen by tourists on the western slope of Mount Whitney last year, and their tracks have been reported on Sugar Loaf Creek this year. Wolverine tracks have been reported on Kern River this year, while badgers have been noted at Willow Meadow. The last wolverines taken in the vicinity of the park, of which we have record, were the five trapped during the winter of 1924–25. Two were taken at Big Meadow, two at Mineral King, and one at River Valley. Of the 5 taken, 4 were males and 1 female. They were all beautiful specimens and in fine condition. This trapping near the park boundaries has, of course, been responsible for diminishing the fur-bearing animals.

"Two native species—the gray wolf³¹ and the California jack rabbit—have disappeared. The only gray wolf seen within the park

³⁰ Probably refers to *Lynx rufus californicus*.

³¹ We know of no timber-wolf specimens from this region, but Judge Fry's account of the wolf is respectfully submitted.

since the time of its creation was one killed by Charlie Howard at Wolverton, September 25, 1908. Mr. Howard at the time was slaughtering beef for a troop of soldiers, and the wolf came up within 50 yards of his camp in broad daylight and was eating on some of the beef offal. It was a large male in fairly good condition, but quite old, as evidenced by badly worn teeth. California plains jack rabbits have always inhabited sparingly a small area at Shepherd Cove and Ash Mountain within the park; but during the summer season of 1918, when poisoned grain was put out along the park boundary to kill ground squirrels, it not only killed the squirrels but the rabbits as well. None of the rabbits have been seen within the park since August 25th of that year.

"The opossum, an animal foreign to the region, has recently arrived in the park. These animals are one result of the drought of 1924, when the waters over their breeding grounds, some 15 miles west of the park, dried up. As the waters dried out, the opossums kept following up the Kaweah River into the mountain section, until they reached the park on September of that year. Quite a large colony of the animals is reported living at Camp Potwisha in the park. The opossums are descendants from stock imported from Missouri some 25 years ago and liberated a short distance east of Visalia.

"I have not listed the California grizzly bears in this report, because we have never considered them a resident of the park; although at very rare intervals individual animals have been reported within the park, and a few have been killed west of the park. From 1921 to 1922, a large bear seen at various times within the park was, undoubtedly, a grizzly. This is possibly the bear killed at Horse Corral by Jesse Agnew in 1922.

"So comparing the wild animals of Sequoia National Park for 1931 with those of the first survey of 1906, 25 years ago, we find the following changes:

"Of the 63 known species that inhabited the park in 1906, 2 have increased, 35 have held their own, 21 have been greatly reduced, 3 are verging on extinction, and 2 have disappeared. One animal has been added, the opossum . . . "

It is obvious from the foregoing that the present park is insufficient to protect its wild life. It is less than 10 miles wide in the middle. There is not an acre of ground within the park which is not less than 10 miles from some portion of the boundary, and fully four-fifths of the park is within 5 miles of some portion of the boundary. It could not be expected that a preserve drafted in such fashion could maintain wilderness conditions. If the natural resources of the park are to be preserved unimpaired, the park area must be made adequate for its animal inhabitants. In the region about the park,

mountain lions have been persistently hunted; the fur-bearers have been reduced by trapping; deer and game birds are hunted annually; the timber has been cut to the park boundary in some places; and the grazing of domestic stock has depleted the range. All these activities drain away the animal life and destroy the values for which the park was created. If Sequoia is to save a sample of the Sierra and Sierran life for all time, it should include the Kings River country immediately adjacent to the north, sufficient territory for deer winter range on the west, the Mineral King country on the south, and enough of the east side of the Sierra to provide for the few remaining mountain sheep and high-mountain fur-bearers. Especially is the Kings River country necessary, because it would provide the solid block of protected territory sufficient to maintain normal wild-life conditions. It is scenically tremendous, but is being ruined for both people and animals by overgrazing. On a 4-day pack trip through the Sugar Loaf Meadow and Deadman Canyon regions in 1930, there was not sufficient food, except in a few local areas, for a burro; it was necessary to pack grain. Deer and all other forms of wild life were scarce, and the cattlemen with whom we talked said that every form of life was getting scarcer each year.

Within the park, faunal problems are similar to those outlined for Yosemite, i. e., concentration of deer and bear in the centers of human habitation; the problem of trampling down the range by thousands of people; the restoration of the normal predator population; the restoration of the fur-bearers; the preservation of the rare game birds; the human and animal adjustment in so small an area; and the exclusion of exotics, such as the opossum.

No intensive faunal survey has ever been made in Sequoia, as has been done for Yosemite³² and Lassen.³³ This should be undertaken before the original picture is too far gone to be restored.

YOSEMITE

Animal life in Yosemite presents much the same picture that it does in the other national parks of this group, though it is somewhat better off by reason of the greater size of the area. It is trapped and shot all around the edges of the park, its winter range either taken or endangered, and its very presence in the park resented by the local grazing industry. The park is accused of being the breeding den of all the predators in the region, and outside pressure is

³²Animal Life in the Yosemite, by Grinnell, Joseph, and Storer, Tracy I. University of California Press, Berkeley, Calif., 1924.

³³Vertebrate Natural History of a Section of Northern California Through the Lassen Peak Region, by Grinnell, Joseph, Dixon, Joseph, and Linsdale, Jean M. University of California Press, Berkeley, Calif., 1930.

brought to bear upon the very existence of the animal life within the park itself.

The national value of our few isolated parks is seldom perceived locally when their presence conflicts with local interests. The whole situation was voiced bluntly by an inhabitant near Bryce Canyon, who said, "I don't see nothin' to rave about in them cliffs. We've lived here all our lives and never even thought about 'em. They just made it a park because some rich guy wants the deer for himself."

On the west side of Yosemite, the boundary cuts arbitrarily across all the water drainages, leaving the deer winter range outside of the park. In a niche of the boundary a private hunting preserve has been established directly across the main migration route of the deer. In the fall of 1931, thirty-seven deer were shot from the porch of the hunting lodge. Furthermore, exotic game birds have been introduced into this preserve. In the Wawona district, just outside the southwest corner of the park, the State lion hunter has killed 31 mountain lions since 1915, and correctly says that he can get every lion in the park without crossing the boundary. The lumber industry has eaten the forest to the very edge of the park in many places. Needless to say, all animal habitats are disrupted in the process. As far as the animal life of the park is concerned, the situation is like a reservoir with the downhill side wide open.

On the east side of the park the boundary follows the crest of the Sierra, but the higher park zones flow over and around the tall peaks of the crest, leaving these reservoirs of animal life wide open on the east side. One trapper, who has been established on the east boundary for 11 years, says that he caught 42 martens the second season. Since then his catch has dwindled until he took only 11 martens two years ago, and none this last season. He has taken six fishers and one wolverine from the territory, and many foxes, including silver, black silver, cross and red pelts. Of course, he has taken many weasel, wild cat, badger, and coyote pelts. While we believe implicitly in the personal integrity of this man, and are convinced that he does no trapping within the park, the situation is fundamentally all wrong. All of these animals trapped are of the roaming type. The trapper says that he knows marten will roam many miles in a day if food is scarce. It is, therefore, possible for trappers to drain off nearly the whole population of high Sierran fur-bearers from Yosemite National Park. These men are not to blame; they are only taking what is lawfully theirs. The fault is in the location of the present boundary. It should extend far enough down the eastern slope of the Sierra to include at least the Canadian Zone fauna. In a park such as Yosemite, where there are isolated

faunal zones unprotected on one side, it is almost as if these zones were not in the park at all.

Most of the major animal problems of Yosemite have already been treated throughout this report.

BLACK BEAR (*Euarctos americanus*).—In dealing with the bear problem elsewhere, an attempt has been made to analyze the basis of the trouble. For the benefit of similar situations, the practical measures which have been tried in Yosemite Valley to meet the immediate problem are given.

1. Signs warning people not to feed the bears have been posted.
2. Food-storage places have been bear-proofed by various means.
3. Bears are fed several miles from human habitation down the valley.
4. The feeding takes place three times each day—mid-morning, mid-afternoon, and evening. It is found that this does not interfere with the evening presentation of the bears.

5. A deadline is established across the valley below the centers of human habitation, and means are employed to make a bear unhappy above this line and quite contented below it.

hours until it is thoroughly frightened and tired. Then it is allowed to come above the line. German police dogs and dovers have proven more satisfactory than wire-haired terriers. This measure has proven somewhat successful, according to Superintendent Thomson, but has been disappointing because of the difficulty of handling the dogs properly, the difficulty of procuring the right dogs, the problem of training the dogs, the fact that the dogs become pets, and that they make even more noise than a bear in a garbage can.

(b) When a bear is found above the deadline, it may be treed for several hours until it is thoroughly frightened and tired. Then it is allowed to come down and is chased away.

(c) Bears above the deadline may be trapped bodily and deported to more remote sections of the park.

6. Individual bears which are dangerous are shot.

Superintendent Thomson hopes by these means to train the cubs to stay out of the upper end of the valley. These methods are still in the experimental stage.³⁴

WOLVERINE (*Gulo luteus*).—See pages 44–46.

CALIFORNIA OTTER (*Lutra canadensis brevipilosus*).—In August, 1928, remains of an otter were found at Babcock Lake. There had been previous reports of otters having been seen in the region. If they are present, they are not abundant, and are therefore in need of absolute protection from human interference.

COYOTE (*Canis lestes*).—See pages 47–49.

MULE DEER (*Odocoileus hemionus*).—See pages 35–36.

SIERRA NEVADA MOUNTAIN SHEEP (*Ovis canadensis sierrae*).—See pages 24–26.

DWARF ELK (*Cervus nannodes*).—A small band of tule elk has been in Yosemite Valley since 1921. They were placed there as an emer-

³⁴Also see pages 68–70 and 82–84.

gency measure to save the species from extinction. It has been necessary to keep them in a paddock and feed them hay each winter. Their paddock area is severely overgrazed, and the winter feeding is a heavy expense. They are entirely out of their native habitat and are a pauperized exhibit. In such close confinement they are not increasing satisfactorily. The limited valley floor is in great need of every acre of natural meadow land, and can not afford the loss of meadow within this artificial paddock. Every effort is being made to place these elk on a refuge within their native habitat, where their perpetuation in public hands will be assured.

RATTLESNAKE (*Crotalus oreganus*).—See page 68.

In general, the chief faunal problems of Yosemite National Park are: To establish boundaries consistent with the requirements of its animal life; to restore the animals of the park to their former numbers and interrelationships; and to reach an adjustment between the conflicting human and animal needs in Yosemite Valley proper. Next to nothing is known about these problems. Years of research are needed before these things can be accomplished.³⁵

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³⁵Also see pp. 73-76.

EASTERN PARKS

Acadia and Great Smoky Mountains already form the nucleus of this group which in the near future may include Shenandoah, Mammoth Cave, Isle Royale, and the suggested Everglades national parks. The conception of a chain of national parks in the densely populated country east of the Mississippi River is a recent one. Their principal function will be to preserve the fragrant restfulness of wilderness life close to the great centers of industry and commerce.

These eastern parks will never boast the massive grandeur or the grotesque formation and fantastic coloration that abound in the parks of the West. Theirs is a different, albeit just as pleasing, charm. It is made of the beauty of lush grasses, of rioting autumn colors, of the varied hardwood forest, of spring flowers, of colorful birds, and of hazy green-clothed mountains and the clearest sparkling waters.

The very essence of these parks will be their wild life, both plant and animal. It will have to be carefully protected. The fauna particularly has been ravished by several generations of unremittent hunting and trapping. It will take additional years of careful nursing to restore its primitive vigor.

The task can only be accomplished on the broad base of boundaries that are adequate to wild life in the first place. The valuable, if sad, experiences gained in the western parks caution the need for careful preliminary investigation of faunal requirements before drawing original boundaries.

In the faunal surveys of these parks relatively heavy emphasis will fall on the work of determining the primitive wild-life picture and tracing the influence of human history on the wild life. The original picture has been obscured in a region so long occupied, and the maladjustments are correspondingly numerous.

Whereas the other parks of the group will have general biotic similarities, Everglades is the exception that its name indicates. It really belongs in a distinct group with itself as the only member.

Great Smoky Mountains and the Everglades were the only eastern park projects visited in the preliminary survey.

PROPOSED EVERGLADES

Discussion of wild-life problems and relationships in national parks would be decidedly inadequate if it did not include this particular proposal. For here the wild life is the park. It is the scenery

and the whole interest, the only bit of the life of the humid tropics to be found in the continental United States.

And amid all the fascinating forms of wild life in which the watery wilderness abounds, the birds are the most spectacular. The great flocks of wood ibises, American egrets and snowy egrets, the roseate spoonbill, white ibis, glossy ibis, least bittern, great white heron, great blue heron, reddish egret, little blue heron, Louisiana heron, green heron, black-crowned night heron, yellow-crowned night heron, and the sandhill crane are among the treasures of the Everglades.

Besides these breeding birds, there is the bizarre flamingo which used to be a visitant and would perhaps come back again under park protection.

Nor are the waders the only bird prizes. Among a host of others are the beautiful Everglades kite, the water turkey, reminiscent of the age of reptiles, and the wild turkey, still common but under constant persecution.

Alligators and crocodiles are two reptiles of largest size which, when they become common enough again to be frequently seen, will be one of the most interesting features of the park.

The manatee is a rare specialized mammal which should have park protection. Other mammals without such extreme specialization which have still been able to adapt themselves to the environment of the Everglades are deer, mountain lion, wild cat, and black bear. Raccoon and otter, of course, are right in their element.

Wild-life problems of this proposed park will be chiefly of two causes—historical and competitive. Fortunately, the chances of their being successfully solved are excellent.

The history of man in the area has been a shocking one of exploitation and waste of faunal resources. It is to the lasting credit of the National Association of Audubon Societies in bringing about a cessation of the feather trade and in maintaining a warden service since, that the fatal influences were ameliorated before it was too late. Largely because of this, it is safe to say that the problems which the Service will inherit from adverse early influences will gradually right themselves within a few years after complete park protection is in effect.

The second group of problems will originate with the advent of the park itself, from the conflict of man and animal (chiefly the birds this time) in joint occupation of the area. Yet there are two good reasons for believing that the native wilderness values will be successfully maintained.

In the first place, the physical characteristics of the terrain are in favor of the wild life. People can not wander at will over the landscape. On land, their movements will be circumscribed by the

limits of the development areas. In boats they will only be able to go where guides are licensed to take them. A stranger might soon be lost on these trackless waterways. Thus, though it would seem to be an anomaly at first glance, large numbers of people can be admitted to the area without disturbing the great rookeries. This will require a certain amount of precaution in locating a few roads and utility areas and in marking the water lanes, plus a few reasonable restrictions upon visitors in some critical areas.

The very fact that the whole problem of relationship between man and the wild life has been apprehended in advance of development

FIGURE 53.—In the Everglades the wild life provides the greatest scenic value. Following the wise example of Japan, it might be well to designate birds like these wood ibises as national parks themselves. Photograph of wood ibis rookery in Florida Everglades by courtesy of Ernest F. Coe

is the second reason for believing that the native values will be preserved. It means that the task will be one of prevention and not one of casting about for remedies after irreparable damage has been done. The manner in which the whole project is being approached by everyone connected with it is proof of the remarkable evolution of the national-park idea in the few short years since it was born in the minds of the members of the Washburn-Doane Expedition in the far-away Yellowstone.

From the basic need of setting aside certain areas that they might be preserved for the enjoyment of all, the idea has grown until now in its highest refinement the greatest emphasis falls upon the manner of presentation of visitors to the treasures contained in those areas.

That the underlying problem in development of the Everglades will be to secure the proper presentation in order that the wild life may be conserved and at the same time utilized for human enjoyment, has been so clearly set forth in the closing paragraphs of the report of Frederick Law Olmstead and William P. Wharton that they are quoted fully here:

"It is essential that the rookeries be protected from intrusion, be made inviolate sanctuaries for the birds; but experience along the trail has demonstrated that with prevention of shooting and with entirely practicable regulation of public behavior, great numbers of people can be given opportunity to enjoy the sight of amazing throngs of birds at some of their great feeding grounds, and we believe it will be safely practicable to admit large numbers of people to observation places so related to the rookeries that the still more amazing concentrated flights of homing birds at sunset will pass over them as they return from the feeding grounds.

"Where these observation places can best be located and how arranged, how people can best approach them, in what cases by automobile and in what cases by boat, and in general how it can be made possible for large numbers of park visitors to get these and other enjoyments offered by this region, and peculiar to it, without serious defacement of the landscape by artificial elements and also (what is here even more important) without upsetting the extraordinarily intricate and unstable ecological adjustments upon which the whole character of the region depends, is a problem that requires prolonged and intensive study from many points of view by the most competent people—botanists, zoologists, and geologists as well as engineers and landscape architects. We are satisfied that it can be solved, and well solved; but we can not too strongly urge caution, thorough study, and patience in the formulating of comprehensive and far-seeing plans before any physical changes, however innocent in seeming, are undertaken".³⁶

GREAT SMOKY MOUNTAINS

The proper establishment of a national park is the most important factor to its wild life thereafter. Either the park embodies the life-zone habitats of its fauna or else faunal complications follow until the situation is rectified, and in the meantime certain rare species are apt to go over the brink.

Before the boundary of the Great Smoky Mountains National Park is finally established there should be a study of the winter range to be sure that the deer and other roving animals of the park

³⁶ The Florida Everglades, by Olmstead, Frederick Law, and Wharton, William P. American Forests, vol. 38, no. 3, March, 1932, p. 192.

are provided for permanently, within the park. If the boundary is placed along a small stream at the bottom of a valley used in winter by the park animals, the boundary should be moved far enough up the other side of that valley to insure complete protection of that winter range area. Otherwise, the game is left with practically no protection when it is most needed.

There will have to be a great deal of restoration before the Great Smokies fauna can begin to resemble its former status. The region has been inhabited for generations, and the animal life utilized until it is no longer abundant. The park lies naturally within the range of the opossum, black bear, raccoon, long-tailed weasel, mink, otter, skunk, red fox, wolf, wild cat, mountain lion, gray squirrel, fox squirrel, red squirrel, flying squirrel, chipmunk, woodchuck, rabbit, beaver, muskrat, white-tailed deer, elk, and many others, but these are at least representative of the animal life which could be expected under normal conditions. Whether all these would exist naturally in the Great Smoky Mountains within the park proper, would have to be worked out. Wild turkey is also present, although this turkey is reported to be a hybrid with the domestic turkey.

One of the most important projects in order to rehabilitate this park would be the early establishment of a faunal survey to gain intimate knowledge of the present wild-life situation, its picture in the past, and the practical steps toward restoration and protection

TERRITORIAL PARKS

Two national parks are instrumental in the conservation of wild life in territories belonging to the United States.

Hawaii National Park, located on Hawaii and Maui Islands of the Hawaiian archipelago, regrettably could not be included in the itinerary of the preliminary wild-life survey. The well-known story of decimation of the native fauna of the islands following the introduction of exotic animals from the continents is suggestive of the many wild-life problems to which Hawaii National Park must be heir. A faunal survey to determine what administrative program will be most effective in preserving the wild life of the park in as nearly a primitive state as is humanly possible should be undertaken by the Park Service at the earliest practicable date.

Mount McKinley National Park is located in the central region of the Territory of Alaska on the slopes of the Alaska Range. Even though it is second to none in importance of wild life, the great game herds having been the principal motive for its establishment, this park was not visited in the preliminary survey. Aside from inaccessibility, the reason for omission from the itinerary was a previous study, covering a period of three and one-half months, which two of the authors made in the summer of 1926 on an expedition financed by Mr. John E. Thayer, of Lancaster, Mass., and the Museum of Vertebrate Zoology, University of California. The perspective obtained on this trip and subsequent reports received from officials of the park are basis for the following discussion.

By reason of the urgent need for a complete study of the faunal problems, one field party of wild-life survey will spend the 1932 season in Mount McKinley Park.

MOUNT MCKINLEY

The relatively large size of Mount McKinley among the national parks (its 3,030 square miles are only exceeded by the 3,438 square miles of Yellowstone) would argue a vast game refuge. Yet this conception is somewhat erroneous in that at least two-fifths of the total area can not be occupied by most forms of vertebrate life.

Timberline is near 3,000 feet. Favorable habitats continue upwards for perhaps another 3,000 feet. But everything above the 6,000-foot contour is a barren waste, and many hundreds of square miles on the slopes of Mount Brooks, Mount McKinley, and Mount

Foraker are bare rock and ice. Precipitation is heaviest on the south side of the crest, causing very extensive glaciation, and the terrain is extremely rough, a combination so forbidding to life that even man has been content to leave the region unexplored.

Only the eastern end and a long narrow strip running the length of the northern boundary favor considerable populations of the larger mammals, and large parts of this area are uninhabitable in winter for some forms that are obliged to leave the park for more clement locations on the great plains of the Yukon. Even the moun-

FIGURE 54.—The combination of altitude and latitude is such that much of Mount McKinley National Park is not available for wild life. Photograph taken July 14, 1926, in Mount McKinley. Courtesy of the Museum of Vertebrate Zoology, University of California, Berkeley, Calif. Mus. Vert. Zool. No. 5044

tain sheep leave the main Alaska Range to winter on the northern, or secondary, range, which, fortunately for them, is still in the park though perilously close to the boundary.

It is a prediction worth hazarding that in time to come the north side of the park will be extended still more to include a representative sector of the gentle plain which slopes away from the mountains toward the Yukon River. Addition of a part of this beautiful boreal forest of mixed conifers and hardwoods will give the park its complement to the bleak grandeur and scant growth which characterize its present area. And, what is more vital yet to an area that protects wild life primarily, is that such an enlargement would suffice

to make the park a satisfactory faunal unit. Several species, such as moose, which only wander up in the summer into the higher areas now occupied by the park, would be embraced in the fold as bona fide residents, and others, such as the spruce grouse, would be added to the faunal quota. Range requirements of animals now forced beyond the park in search of lower levels would be fulfilled and a greater margin of safety from poaching provided for other species, notably the sheep.

Poaching is one of the most serious problems of Mount McKinley Park and may continue to be of great concern for some time, though it should be a steadily diminishing factor. In Alaska there are many so-called prospectors who, during the winter months, "live off the country." They trap the fur-bearers and find subsistence for themselves and their dog teams by shooting the game. What they eat themselves is of minor importance, but it takes much meat to feed the dogs. If game is abundant, their methods are frequently very wasteful. A whole sheep may be used for a day's ration for one dog and a caribou may be thrown to two. Sometimes a cache is made of a quantity of game when the opportunity to make a slaughter occurs, on the assumption that it will keep well in the freezing weather and can be utilized when the same spot is revisited on another round.

The abundant and increasingly fearless animals of the park are a temptation to some of these men, especially as they resent the withdrawal of the area from the only good use which they could ever see for it in the first place.

Three things will help in the solution of the poaching problem. Each succeeding year sees the park better established in the minds of Alaskans as something contributing to the welfare of the Alaska Commonwealth and as an entity to be respected. Secondly, the permanent ranger force, starting with the inadequate nucleus of one, will be enlarged as appreciation of the park's needs and tremendous value brings increased appropriations. Constant patrols are needed throughout the year, particularly in winter, and no less than five rangers should be available to properly discharge this function. The third thing required is the boundary extension mentioned above. If the line could be moved still farther to the north so as to leave the secondary range well within the park instead of at its very edge, poaching of sheep could be prevented. Under the present condition, even a full patrol force could not be expected to effectively surmount the handicap.

In gaging the status of wild life in Mount McKinley Park, every allowance must be made for natural cyclical fluctuations of animal

populations. In the far north the fauna is poor in species and rich in numbers, and there is a pronounced tendency for periods of great abundance to alternate with lean years in a seemingly rhythmic succession. Other than that these fluctuations in animal numbers do occur, little is known about them. It is one of the most promising fields for investigation in field-vertebrate zoology to-day. Old residents claim that periods of abundance, considering the vertebrates as a whole, occur every six or seven years in this region. However this may be, and whatever the cause or causes, the significant thing to keep in mind is that it is a wholly natural phenomenon. All that the park administration can do or should attempt to do is to guard against any man-caused influences which will affect this natural interplay of forces. If the game dwindles, it should not be a signal for control of the native predators. If on the next swing it seems to become overabundant for the range, no measures should be taken to augment the natural controls which will just as surely appear to reduce its numbers as has always happened before. Any attempt to maintain animal numbers near a mean level would be bound to fail and would probably cause serious maladjustments in itself. Even if it could succeed, the instructive and fascinating story of wild life in the north would be lost.

BARREN-GROUND CARIBOU (*Rangifer arcticus*).—The danger of dilution of the native caribou stock by hybridization with domestic reindeer has been discussed on page 50 as an illustration of this important type of faunal problem. As the park caribou join the annual run which takes them many miles away, they can never be provided for strictly within the park. The fate of the park caribou will be one with the fate of the larger herd of which they form a part. The problem is more than local, with the park playing the role of custodian on one of the important breeding grounds during that critical time in the annual cycle.

DALL SHEEP (*Ovis dalli dalli*).—The beautiful white Dall sheep are easily the greatest of the many animal attractions in the park. As they remain within the boundaries the year through and there is no present danger of contamination with the diseases of domestic sheep in this northern latitude, their present satisfactory status can be expected to continue.

There are only two adverse influences to be feared at present: Poaching, which has already been mentioned, and loss of lambs to the coyote. Wolves, wolverines, lynxes, and golden eagles have undoubtedly taken their annual toll for thousands of years without endangering the survival of the sheep, but the coyote is an added enemy of no small power which might turn the balance. It should be kept out if

possible. The incipient invasion of this species in the McKinley district has been discussed on pages 47-49 as a typical example of the problem of invasion of exotics in the national parks.

ALASKA MOOSE (*Alces gigas*).—Moose, to a limited extent, move into the park around timberline and above in the summer. They were seen on a few occasions by the expedition in 1926. Extension of the park to the north would add enough typical moose habitat to make the largest of the deer tribe one of its certain attractions

FIGURE 55.—The caribou of Mount McKinley leave the park seasonally. Hence their fate is one with that of the larger herd of which they form a part during the rut. Photograph taken June 27, 1926, at head of Savage River, Mount McKinley. Courtesy of the Museum of Vertebrate Zoology, University of California, Berkeley, Calif. Mus. Vert. Zool. No. 4963

and would help to avert such situations as the one exemplified in the following excerpt from a report on the fauna of the park in February, 1932:³⁷

“The heavy snows which came during the fore part of the month were followed by two days of rain, then below-zero weather, and a heavy crust was formed which has caused untold suffering among all the wild animals in the interior of the park. This is especially true concerning moose.

³⁷ Monthly Report of Superintendent of Mount McKinley National Park, February, 1932.

"Their legs from the knee down are worn to the bone, and each moose trail is covered with blood. It is possible to walk right up on moose, as they have not the courage or strength to try and run away.

"The tribe of Nenana Indians has been hunting them just north of the boundary line, along the McKinley River, and has driven them up into the park. The ranger in that district reports seeing as many as 15 or 18 in a band."

ALASKA BROWN BEAR (*Ursus kiddlei tundrensis*) and TOKLAT GRIZZLY BEAR (*Ursus toklat*).—Both grizzly and Alaska brown bears are scarce in the park. Bears are anathema to the people of interior Alaska and are killed at every opportunity. It is doubtful if their numbers have increased manyfold since the establishment of the park. They range widely and are probably taken outside the boundaries. It is very desirable that they should increase once more and become safely established in their rightful place among the park fauna. A widening of the narrow inhabitable belt between the high mountains and the present north boundary is about the only measure which will help the bear.

MOUNT MCKINLEY TIMBER WOLF (*Canis pambasileus*).—Among all the national parks in which the timber wolf was once native, Mount McKinley is the only one where it is now definitely known to occur regularly. Whether it will continue in the park in the face of insistent persecution outside is a question; but every effort should be made to save it. The arrival of the coyote as a competitor may further endanger its status. One pair of wolves was observed at Savage River on the 1926 expedition.

ALASKA RED FOX (*Vulpes alascensis*).—The big bright red foxes are especially important in wild-life presentation in this park. Visitors can not be assured of seeing the large game every day but there is always a fox den surrounded by ptarmigan wings and snowshoe rabbit feet where the adult red foxes and their playful pups will hold the attention of the spectators for hours at a time. Here again the coyote looms on the horizon as a dangerous competitor which may largely supplant the red fox unless its spread can be checked.³⁸

MOUNT MCKINLEY WOLVERINE (*Gulo hylaeus*).—Wolverines in the parks within the United States have been discussed on pages 44-46. There they are either gone or are on such precarious footing that their complete extermination is greatly feared. In Mount McKinley they are still well intrenched. Their value is the greater because of their scarcity elsewhere, and they should be carefully watched. Tracks were seen in Savage River Canyon in 1926.

³⁸ See pp. 47-49.

ALASKA PTARMIGAN (*Lagopus lagopus alascensis*).—Among the birds the Alaska ptarmigan is the most conspicuous and of greatest appeal to the average visitor, though the fact that rock and white-tailed ptarmigans also occur and that each of the three occupies a distinctive ecological niche is even more interesting to the bird student.

FIGURE 56.—The Alaska ptarmigan is abundant during certain years and rare at others. Cyclical fluctuations of great intensity are normal for this species and man can not hope, nor should he ever try, to regulate their populations near a constant level. Photograph taken May 25, 1926, on Savage River, Mount McKinley. Courtesy of the Museum of Vertebrate Zoology, University of California, Berkeley, Calif. Mus. Vert. Zool. No. 5112

The Alaska ptarmigan is one of the species whose fluctuations in numbers are almost as marked as those of the snowshoe rabbit. Their fortunes are followed by the lynxes and the red foxes that are chiefly dependent on them. The normal interrelations and the swing of these cycles should not be disturbed.

SUGGESTED NATIONAL-PARK POLICY FOR THE VERTEBRATES

Every tenet covering the vertebrate life in particular must be governed by the same creed which underlies administration of wild life in general throughout the national parks system, namely:

That one function of the national parks shall be to preserve the flora and fauna in the primitive state and, at the same time, to provide the people with maximum opportunity for the observation thereof.

In the present state of knowledge, and until further investigations make revision advisable, it is believed that the following policies will best serve this dual objective as applied to the vertebrate land fauna. Without further comment, inasmuch as the supporting reasons have been developed in preceding sections, it is proposed:

Relative to areas and boundaries—

1. That each park shall contain within itself the year-round habitats of all species belonging to the native resident fauna.

2. That each park shall include sufficient areas in all these required habitats to maintain at least the minimum population of each species necessary to insure its perpetuation.

3. That park boundaries shall be drafted to follow natural faunal barriers, the limiting faunal zone, where possible.

4. That a complete report upon a new park project shall include a survey of the fauna as a critical factor in determining area and boundaries.

Relative to management—

5. That no management measure or other interference with biotic relationships shall be undertaken prior to a properly conducted investigation.

6. That every species shall be left to carry on its struggle for existence unaided, as being to its greatest ultimate good, unless there is real cause to believe that it will perish if unassisted.

7. That, where artificial feeding, control of natural enemies, or other protective measures, are necessary to save a species that is unable to cope with civilization's influences, every effort shall be made to place that species on a self-sustaining basis once more; whence these artificial aids, which themselves have unfortunate consequences, will no longer be needed.

8. That the rare predators shall be considered special charges of the national parks in proportion that they are persecuted everywhere else.

9. That no native predator shall be destroyed on account of its normal utilization of any other park animal, excepting if that animal is in immediate danger of extermination, and then only if the predator is not itself a vanishing form.

10. That species predatory upon fish shall be allowed to continue in normal numbers and to share normally in the benefits of fish culture.

11. That the numbers of native ungulates occupying a deteriorated range shall not be permitted to exceed its reduced carrying capacity and, preferably, shall be kept below the carrying capacity at every step until the range can be brought back to original productiveness.

12. That any native species which has been exterminated from the park area shall be brought back if this can be done, but if said species has become extinct no related form shall be considered as a candidate for reintroduction in its place.

13. That any exotic species which has already become established in a park shall be either eliminated or held to a minimum provided complete eradication is not feasible.

14. That the threatening invasion of the parks by other exotics shall be anticipated; and to this end, since it is more than a local problem, encouragement shall be given for national and State cooperation in the creation of a board which will regulate the transplanting of all wild species.

Relative relations between animals and visitors—

15. That presentation of the animal life of the parks to the public shall be a wholly natural one.

16. That no animal shall be encouraged to become dependent upon man for its support.

17. That problems of injury to the persons of visitors or to their property or to the special interests of man in the park, shall be solved by methods other than those involving the killing of the animals or interfering with their normal relationships, where this is at all practicable.

Relative faunal investigations—

18. That a complete faunal investigation, including the four steps of determining the primitive faunal picture, tracing the history of human influences, making a thorough zoological survey and formulating a wild-life administrative plan, shall be made in each park at the earliest possible date.

19. That the local park museum in each case shall be repository for a complete study skin collection of the area and for accumulated evidence attesting to original wild-life conditions.

20. That each park shall develop within the ranger department a personnel of one or more men trained in the handling of wild-life problems, and who will be assisted by the field staff appointed to carry out the faunal program of the Service.

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